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Sumit Singh

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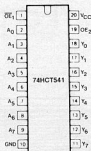
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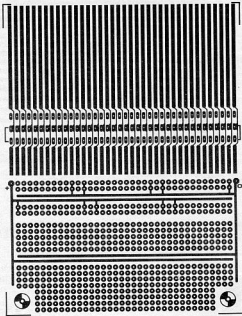
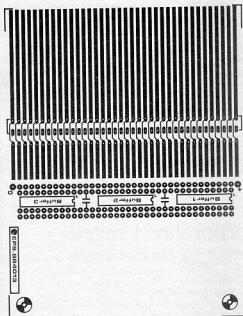
PROTOTYPING BOARD FOR COMPUTER EXTENSIONS

This printed circuit board is ideal for building and testing experimental extension circuits for a wide range of computers. The double-sided, but not through-plated, board has contact fingers that enable it to be accepted in commonly used slot connectors for extension circuits in many types of computer, including those in the MSX and IBM PC series. In addition, the board holds 3 general-purpose buffer chips which can be wired to requirement to ensure correct and safe interfacing between the computer and the extension circuit being developed. Supply tracks are provided in the buffer and prototyping area on the board for ease of wiring. When required, a number of contact fingers can be cut off to suit a particular slot width, or to prevent the board being fitted the wrong way around in the slot. Also, the contact fingers are relatively long so that a section of this PCB area can be cut off for use as an adaptor

together with a purchased slot connector. It is also possible to fit a slot connector at right angles to either side of the PCB as shown by the printed markers. The pin connections of the Type 74HCT245 octal transceiver, and the Type 74HCT541 octal three-state line buffer are given here for reference. These chips are suggested for use as databus and addressbus buffers respectively, because they have inputs and outputs arranged at opposite sides of the 20-way DIL enclosure. The user is, however, left completely free to choose his own bus buffers in accordance with the interfacing requirements. Remember to ground unused inputs on HCT chips!



804013-10



THREE-WAY TONE CONTROL

Although tone control is not desirable in good-quality audio equipment, there are still instances, such as when playing well-used records, when it is. Such an add-on tone control should enable the frequency response to be altered to taste, have no detrimental effect on the audio equipment, and be fairly compact. The circuit proposed here meets these criteria.

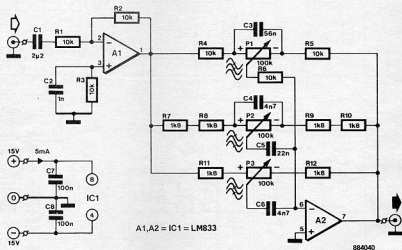
It is based on National Semiconductors' LM833. This dual operational amplifier has a very low noise factor (4.5 nV/√f (Hz)), a high gain-bandwidth product (15 MHz), and a slew rate of 7 V/μs.

The tone control circuit consists of three ranges, so that a presence control at around 1 kHz is possible.

The opamp at the input, A₁, is connected as an inverting buffer. Its non-inverting input is connected to a 10 k resistor to equalize the direct currents at both inputs (with respect to the bias currents). This is necessary to keep the output of A₁ near enough at 0 V because of the d.c. coupling to A₂.

The second opamp has in its feedback loop a simple three-way tone control, whose cross-over points are determined by the value of the four capacitors.

If desired, a capacitor may be added to the output of A₂, because the d.c. output of this opamp varies somewhat with the setting of the potentiometers.



The cross-over points of the low-frequency and high-frequency controls lie at about 200 Hz and 2 kHz respectively. The presence control operates at around 1 kHz. Maximum attenuation is about 16 dB.

With all potentiometers at the centre of their travel, the signal-to-noise ratio is better than 90 dB at a bandwidth of 1 MHz. The gain is 0 dB but can be altered by changing the value of R₂.

DMM AS FREQUENCY METER

By providing a high-input-resistance multimeter (preferably of the digital type) with a frequency-to-voltage converter, it can be used to measure frequency.

The range of the proposed device extends from 10 Hz to 1 kHz on range A and from 1 kHz to 100 kHz on range B. The sensitivity for frequency measurements up to about 10 kHz is of the order of 35 mV_{pp}, and for measurements from 10 kHz to 100 kHz about 350 mV_{pp}.

The input signal is applied to Schmitt trigger IC₁ via limiters D₁ and D₂. Bistables FF₁ and FF₂, and IC₂ form a monostable. When the monostable is triggered, it generates a pulse whose width is accurately determined by a 12-MHz crystal.

The number of times the monostable is triggered per unit time depends on the

input signal.

The pulse height depends on the supply of the monostable. The supply is provided by voltage regulator IC₃ and is about 5 V.

At the output of the monoflop, i.e., pin 13 of FF₂, there will thus be a train of pulses, whose width and height are constant, but whose number and, therefore, the average voltage is directly proportional to the input frequency.

The RC network at the output of FF₂ forms a low-pass filter, so that the average voltage of the pulses will appear across C₄. Potentiometers P₁ and P₂ and resistors R₇ and R₈ form a potential divider which enables the frequency-to-voltage conversion factor to be adjusted.

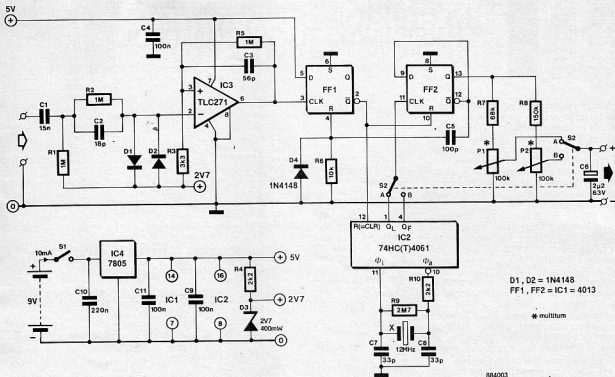
The voltage across C₄ measured by the DMM is thus directly proportional to the

frequency of the input signal.

In range A, a voltage of 10 mV corresponds to 10 Hz, and 1 V to 1 kHz. In range B, 10 mV corresponds to 1 kHz, and 1 V to 100 kHz.

For adjusting the meter, temporarily connect the junction of R₇ and R₈ to pin 12 instead of to pin 13 of FF₂. There should be no input signal. Set the DMM to the 20 V range, and connect it across C₄. Set S₂ to position A, and adjust P₁ until the meter reads 2.93 V. Then set the meter to the 2 V range, and S₂ to position B. Now adjust P₂ until the meter reads 1.875 V. Finally, reconnect the junction of R₇ and R₈ to pin 13 of FF₂.

The meter may be powered by a 9-V PP3 battery; the current consumption amounts to only 10 mA.



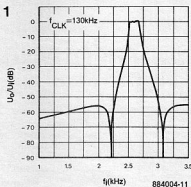
RTTY FILTER FOR 170 HZ SHIFT

Anyone interested in the reception of radio teletype traffic will appreciate the programmable audio filter described here, which may be fitted at the input of the RTTY converter. It improves the signal-to-noise ratio, particularly of signals in the crowded short-wave bands.

The circuit is based on programmable filter IC₁—see Fig. 2. The special facet of this IC is that the resistors of the on-board RC filters are simulated by capacitors. This little-known technique is described in the January 1981, October 1982, and February 1983 issues of this magazine.

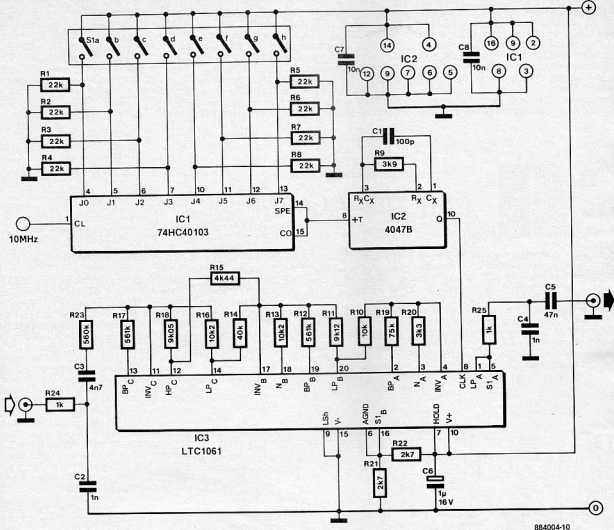
The value of the capacitors, and therefore the pass-band frequency of the filter, is determined by the frequency of the clock at pin 8 of IC₁. The clock frequency is made variable by passing a 10-MHz signal through a programmable divider, IC₂. The divisor may be set between 1 and 256 with the aid of switches S_{1a}—S_{1n}.

Monostable IC₂ converts the output pulses from the divider into a near-symmetrical signal, which is subsequently used as the clock for IC₁ (pin 8).



The filter characteristic is shaped by the resistors at the various pins of IC₁ to a very-narrow pass-band as is required for small RTTY shifts. The characteristic is shown in Fig. 1. The entire pass-band may be shifted with the aid of the switches.

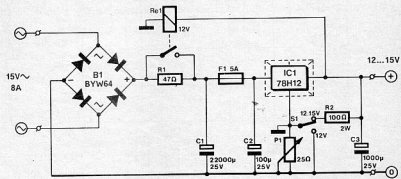
In narrow-band RTTY (70–170 Hz shift), one filter suffices, since both the high and low AFSK frequencies can be passed by the filter. For broadband RTTY signals (425–850 Hz shift), it is probably better to use separate filters for the high and low frequencies. The circuit draws a current not exceeding 20 mA.



884004-10

SECONDARY POWER-ON DELAY

The circuit described here enables short-circuit protection and power-on delay to be added to a power supply. Power supplies with a large reservoir capacitor may draw such large currents on switch-on that problems occur, even at the primary of the mains transformer. Particularly when a toroidal mains transformer is used, it may be necessary to fit a much heavier primary fuse than is desirable for normal protection. The current in the secondary is limited by a resistor, R₁, in series with the reservoir capacitor, C₁. A few seconds after switch-on, R₁ is short-circuited by a relay contact. Compared with switching at the primary side, this method has the advantage that no separate supply for the relay is necessary and that this does not have to switch the 240 V mains.



884039

Operation is fairly simple. After switch-on, C_1 is charged slowly via R_1 . After a few seconds, the output voltage has risen sufficiently for the relay to be energized, which causes R_1 to be shorted. When the output of the supply is short-circuited, the output voltage drops to a level where R_1 is de-energized. Because R_1 is then in circuit again, the short-circuit current is limited and nor-

mally the voltage regulator does not have to limit (less dissipation). Switch S_1 enables a choice to be made between a fixed output of 12 V and one variable between 12 and 15 V. With heavy loads it may occur that the output voltage remains too low, because of R_1 , to energize the relay. In that case it will be necessary to remove the load from the supply before this can switch

on. The earth of the circuit is in a somewhat unusual place to enable IC_1 to be mounted on to the heat sink without an insulating washer (IC ground is connected to its case). For this reason, it is not permissible to use the earth for external ground connection.

CAR TILT ALARM

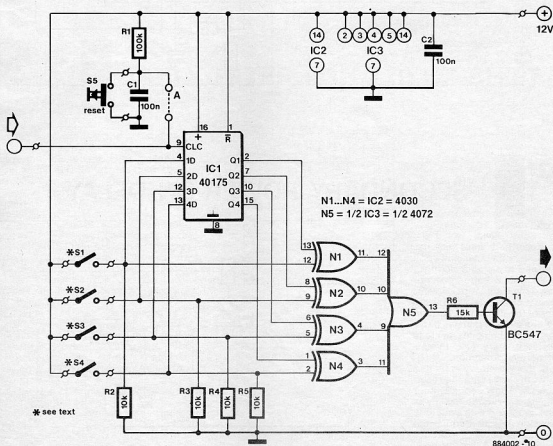
Many cars are fitted with some sort of alarm system as protection against petty criminals and joy riders. Most of these systems rely on a door switch and one under the bonnet (to prevent interference with the battery connections to immobilize the alarm system). Such systems afford no protection whatsoever to another criminal pest: those who jack up the car and remove expensive aluminium sports wheels.

The circuit described here is an add-on to an existing alarm and energizes this when the position of the car is changed, for instance, by a jack being placed under it.

The position of the car is monitored by four mercury switches which are placed in such a way that when the car is horizontal they are open. Because a car is sometimes parked in an inclined position, which causes one or more of

these switches to close, some additional circuitry is necessary.

The four D-type bistables in IC_1 determine the output state of the mercury switches. The outputs of IC_1 are connected to gates N_1 to N_4 which function as inverters when the mercury switches initially are closed (so that there is a 1 at the output of the relevant bistable). This results in the outputs of the four gates remaining 0 as long as the mercury



Parts list

Resistors ($\pm 5\%$):

R1 = 100K
R2...R5 incl. = 10K
R6 = 15K

Capacitors:

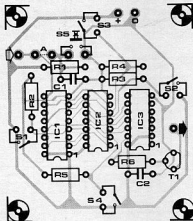
C1, C2 = 100n

Semiconductors:

T1 = BC547
IC1 = HEF40175BP (Phillips Components)
IC2 = CD4030CN
IC3 = MC14072BCP (Motorola)

Miscellaneous:

S1...S4 incl. = mercury contact.
S5 = push-to-make button.
PCB 894002



switches stay in that initial state.

If only one of the mercury switches changes state, the output of N₂ goes high and T₁ switches on. This transistor may, for instance, be connected in parallel with the door switch.

The output state of the bistables may be stored via R₁-C₁ at the moment the supply is switched on. All car alarms have a certain delay after being switched on to give the occupants time to get out of the car. If a signal is available that becomes 1 after this delay, it may also be used to store the output states in the bistables. Resistor R₁ and capacitor C₁ must then be disconnected. This second method has the advantage that if a mercury switch is just about changing state, the closing of the car doors will render it stable.

The mercury switches are mounted on the PCB together with the other components. One of the terminal wires of the

switches must be kept long enough to allow the switch to be slightly tilted with respect to the board. The side of the switch in contact with the board may then be fixed into position with araldite or a similar fixative. This arrangement ensures that all switches are open when the car is horizontal.

3³/₄-DIGIT DPM

Described is a digital panel meter—DPM—which is built around a special meter-IC, Type ADD3701, and may be used for the accurate measuring of voltage from a variety of sources.

A highly stable reference voltage is provided by an LM336. A ULN2003, IC₂, is used to buffer the outputs of the ADD3701, so that the common-cathode displays can be driven direct. The ADD3701 multiplexes the displays so that the number of control lines is kept down. The current through the display segments is limited by resistors R₈ to R₁₅ incl.

The oscillator that determines the conversion rate of the analogue-to-digital converter in IC₁ requires an external RC network (R₇-C₅). Because of the need of adequate suppression of the mains frequency, the oscillator frequency must be exactly 400 Hz (it is very nearly equal

to 0.6R₇C₅). A preset potentiometer may be connected in series with R₇ to adjust the frequency accurately. At this oscillator frequency, there are about 3 conversions per second.

Another possibility of avoiding interference from the mains frequency is to use the DPM for measuring positive voltages only: LD₃ is then not required. The input voltage is applied to V_{IN} (pin 11) via a 100 k Ω resistor. Input terminals V(+) and V(-) are not used in this case. Also, the oscillator frequency need not be exactly 400 Hz.

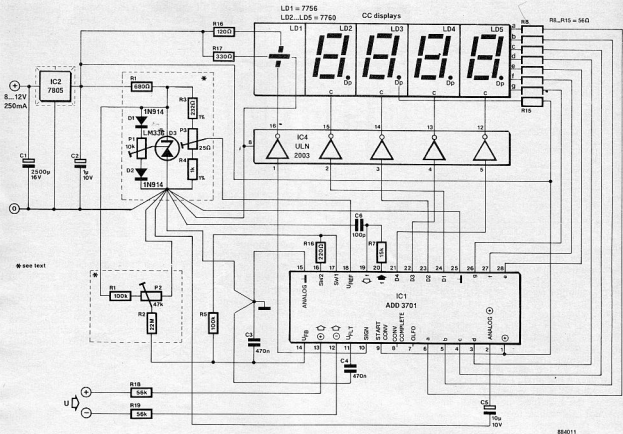
The DPM is calibrated by short-circuiting the input and setting P₂ to a position where the display reads 0.000. Then apply a voltage of 1.900 V to the input and adjust P₂ till the display reads 3.800. An input voltage of 1.999 V will then result in a display reading of 3.999. Take this into account if an input at-

tenuator is contemplated.

The load presented by the input stage to a potential divider at the input is very small: typically, the input current is 1 nA (maximum 5 nA).

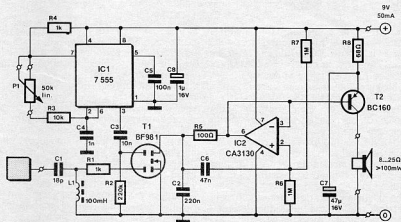
The (unregulated) supply should be able to provide 8 to 12 V at a current of 250 mA. The circuit, including the displays, draws about 150 mA.

(National Semiconductor Application)



DEFLECTION DETECTOR

Repairs to the e.h.t. section of a monitor or a television receiver always carry a certain amount of risk. It makes sense, therefore, particularly for the less experienced technician, to seek a safe way of checking the extra high tension. In all television receivers and monitors, the e.h.t. is generated in the deflection circuits. These circuits operate at about 16 kHz which generates a fairly strong magnetic field via the line transformer. It may be safely assumed that as long as the deflection circuits function correctly, the e.h.t. will also be all right. Admittedly, there is a possibility that a defect high-tension winding may be the culprit. But let's not be pessimistic. . . . The proposed circuit enables 'wireless' monitoring of the e.h.t. section, since it picks up all signals between about 14 kHz and 45 kHz (and their harmonics) and converts them into audio signals. The frequency of oscillator IC₁ may be varied with the aid of a potentiometer. The oscillator output is mixed with the



detected deflection signal in T_1 . Since IC_2 is connected as a gyrator, filter L_1-C_1 at the drain of T_1 removes an audio signal from the mixing product. The small audio signal is amplified in T_2 to a level sufficient to drive a small loudspeaker.

The detector 'probe' is best made from

a short length of insulated equipment wire, preferably, but not necessarily, connected to a small insulated metal plate. To test whether the deflection circuits operate correctly, the monitor or television receiver, as well as the test circuit, must be switched on. Then the probe should be placed in the vicinity

of the line transformer and the potentiometer in the tester adjusted until a constant whistle is audible from the loudspeaker. When the monitor (TV receiver) is switched off, this whistle should disappear. If this happens, the deflection, and therefore almost certainly the e.h.t., will be all right.

009

SIMPLE TRANSISTOR TESTER

While experimenting with electronic circuits, it will often be necessary to rapidly test bipolar transistors and FETs before they are fitted in the circuit, or when they have been removed from the circuit when a malfunction is suspected. More specifically, constructors will need to know whether a transistor of known type and make is sound or not, and also whether an unknown device is a particular type of FET, or a bipolar transistor (PNP or NPN).

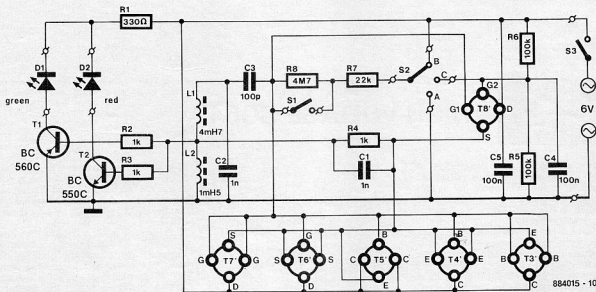
This tester can be built from parts found in the junk-box. When the transistor under test (TUT) is OK and correctly connected, the circuit will oscillate during half the period time of the alternating supply voltage (50 or 60 Hz). Red LED D_2 lights when the TUT is OK and of the NPN type. The function of green LED D_1 is similar for PNP TUTs. The TUT OK/not OK indication is obtained with S_2 set to the centre position, and S_1 opened as shown in the circuit diagram.

The LEDs will indicate that the oscillator amplitude is significantly reduced, or nought, when S_1 is closed with a bipolar TUT mounted. Correctly operating FETs produce oscillation irrespective of the position of S_1 . Only J-FETs and dual-gate MOSFETs produce oscillation when S_1 is set to positions A and C.

The accompanying table should speak for itself. Note that S_1 must be opened and closed after each change in the position of S_2 .

Finally, the tester is preferably fed from a 6 VAC mains adapter.

1



884015 - 10

Parts list

Resistors ($\pm 5\%$):

R1 = 330R
R2, R3, R4 = 1K0
R5, R6 = 100K
R8 = 4M7

Capacitors:

C1, C2 = 1n0
C3 = 100p
C4, C5 = 100n

Inductors:

L1 = 4mH7 radial choke, e.g. Toko Type 181LY472 (Cirkit).
L2 = 1mH5 radial choke, e.g. Toko Type 181LY152 (Cirkit).

Semiconductors:

D1 = green LED
D2 = red LED
T1 = BC560C
T2 = BC550C

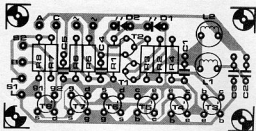
Miscellaneous:

S1 = miniature SPST switch.
S2 = 3-way rotary switch.
6 off 4-pin transistor sockets.
PCB Type 884051

TUT	SWITCH		B o o C		
	S1	S2	A	o	o C
BIPOLAR	• o o	• •			
J-FET	x	• •			
DG-MOSFET	x	o o (U _{g2} = ½ U _d)	• • (g1 to g2)		
ENHANCEMENT (MOS) FET	x	• o			

- = oscillation
- o = no oscillation
- x = irrelevant

2



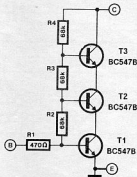
0 1 HIGH-VOLTAGE BC547

It is sometimes desired to use a BC547 at rather higher voltages than permitted according to the data book. Yet, it can be done by connecting a number of them in series as shown in the accompanying diagram.

The set-up has a few, small, disadvantages: there is a constant leakage current through the series resistors and the saturation voltage is rather higher.

Where these disadvantages are of little or no consequence, the circuit shown here can be used with voltages up to about 100 V.

Assume that a voltage of 100 V has to be switched and that the maximum current is 2 mA. If the current amplification is



200, the base current will be $10\mu\text{A}$. Transistor T₃ will then switch on as soon as the p.d. across R₄ is 0.68 V. The base current of T₂ also flows through R₄, so that the drop across this resistor rises to 1.36 V.

The current that switches T₁ flows through R₁, so that it does not cause an additional p.d. across the potential divider. There is, of course, the usual saturation voltage of about 0.2 V across T₁. The total drop across the divider is then $3(10^{-5} \times 68 \times 10^3) + 0.2 = 2.2\text{ V}$.

Increasing the resistor values to 270 k raises the saturation voltage to 8.3 V. The leakage current is then much smaller.

884017

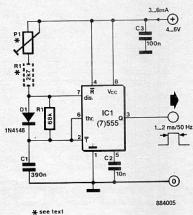
SERVO-PULSE GENERATOR

Circuits for the generation of control pulses for servo apparatus remain popular, which seems a good enough reason to present another one.

The popularity of servo control is enhanced by the low price of servo motors, and the fact that they can be used for a variety of applications. The present design is geared to stand-alone use of the servo.

Simplicity of the circuit was the first design consideration, and it seemed reasonable, therefore, to base it on the well-known 555 IC. Unfortunately, this chip has the property, in its standard configuration, of producing pulse trains with a duty factor* of 50% or greater. This is so, because the charging time constant is always greater than the discharge one, since during charging the discharge resistance is in series with the charge resistance.

Servos, on the other hand, require pulse trains with duty factors well below 50%. Ideally, the pulses should have a width of 1-2 ms, and the pulse repetition frequency - prf - should be about 50 Hz. This gives a duty factor of 5-10%.



This problem may be resolved by inverting the output signal of the 555 with the aid of a transistor and two resistors, but this was considered extravagant. All it needs is an extra diode and relocating the discharge resistance. The charging

time, and therefore the length of time that the output is logic high, is now determined by P_1 , R_1 , and the discharge time through R_2 .

The component values in the circuit have been chosen in a manner that causes the pulse width to change from 1 ms to 2 ms when the resistance between the positive line and the anode of D_1 is increased from 2k7 to 5k4. This reduction in resistance is brought about by a 75° shift of P_1 (normal joystick travel), if this potentiometer has a value of 10k. This potentiometer must be set to a position where its resistance is 4k1 when the joystick is at centre position. Resistor R_1 should then be replaced by a wire link.

It is possible to use the normal 270° travel of the potentiometer, which should then have a value of 2k7. Resistor R_1 must then be used as shown.

*The duty factor of a pulse train is the ratio of the average pulse width to the average pulse spacing of pulses in the train.

SELF-SWITCHING POWER SUPPLY

The proposed power supply switches itself off when no current is drawn by the load. How this is done is shown in the circuit diagram, Fig. 1.

When a load current flows, the p.d. across D_1 is sufficient to cause D_2 and T_2 to conduct. T_1 is then switched on and the relay is energized. When the load current ceases, T_2 switches off. The base current of T_1 will then charge C_2 so that after a few seconds the relay is de-energized. The relay contact, re_1 , will then switch off the mains at the primary

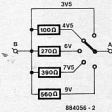
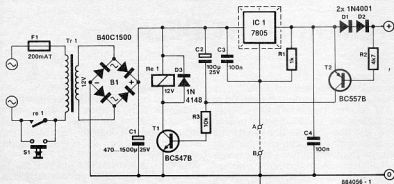
of the transformer. The supply is switched on again by reconnecting the load and pressing S_1 briefly.

The output voltage depends on the resistance between A and B. A wire link there results in an output voltage of about 3.5 V. For each 100R increase, the output voltage will rise by about 1 V (the current from the regulator to ground is a nearly constant 10 mA). This makes it possible to obtain a variable output voltage with the aid of some resistors and a rotary switch as shown in Fig. 2.

The relay, re_1 , should be of a type that is suitable for switching mains voltages.

The a.c. rating of the secondary of Tr_1 must be about 1.5 times as high as the desired d.c. output current. The output current should not exceed 1A; if that magnitude of current is drawn regularly, it is recommended to increase C_1 to 1500 μ F.

The delay in switch-off may be extended by increasing the value of C_2 . The heat sink of IC_1 should be in accordance with the output current.



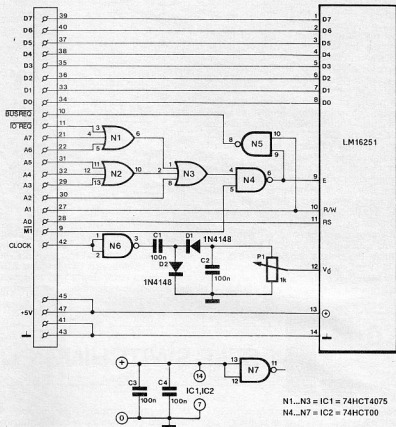
There is a growing tendency to use liquid-crystal displays (LCD) as the screen of computer monitors. Such displays may also be used where the normal monitor is too large or draws too much current; they are readily available. An LCD is normally driven by a micro-processor: in the proposed circuit by a Z80.

The display in the proposed circuit is a Sharp Type LM16251: a full description of this appeared in the May 1986 issue of this magazine. It is located in the I/O region, addresses 0 to 3, of the processor. This arrangement enables the circuit also to be used in combination with the 32-bit I/O and timer cartridge described in the January 1987 issue of this magazine. This cartridge does not use the lowest four addresses (choose address 0 for the cartridge so that an additional I/O region of 0 to 15 is obtained).

The address coding is effected by gates N1 to N4. When A₂ to A₇ are, and IO REQ becomes, low, the output of N₃ goes low. If MI is high (no interrupt demanded), N₄ outputs a 1 and an enable signal is given to the display. Depending on the logic levels at inputs R/W and RS, data is transmitted or received. The RD and WR outputs of the Z80 are not used, because the R/W and RS signals of the LM16251 must be stable not later than 140 ns before the E input goes high. If the RD or WR signals of the processor were used, the E input of the display would be accessed together with the other signals and that is not permitted.

By using an address line, the timing is arranged by that of the Z80, because the address bus must be stable not later than 320 ns (180 ns for Z80A) before an IO REQ signal is generated. Owners of a Z80B-driven computer might have some problems here because the time delay is then only 110 ns. Note that MSX computers invariably use a Z80A.

The negative voltage for the contrast setting (P1) of the display is provided by



N₅. Note that some types of display need a positive voltage for the contrast setting. Wire link 'a' provides a negative supply, and 'b' a positive one. Link 'a' is required for the LM16251. If another type of display is used, make sure that

the pin numbering is the same as shown in the diagram.

Gate N₅ serves to render the BUSDIR line low at an I/O read command in MSX systems. In other systems, this gate is not required.

CAR INTERIOR LIGHT DELAY

It's dark and it's raining cats and dogs. You rush to your car, open the door and quickly close it behind you again. Then you sit there fumbling for the ignition lock. Solution? Add the following circuit, which will keep your car's interior light on for a little while after the door is closed.

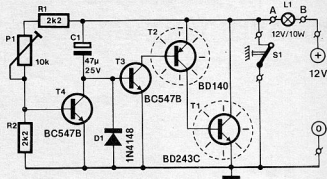
The circuit is connected across the switch in the door post. These switches

are removed quite easily.

In the circuit diagram, S₁ is the switch in the car's doorpost and L₁ is the interior light. As long as the door is open, S₁ is closed and the light is on. When the door is closed, S₁ opens and the light goes out. The full 12 V from the car battery is then present across the switch. The circuit detects when the voltage across S₁ begins to rise. Transistor T₁

and consequently T₂ and T₃ is then switched on. This results in the voltage across S₁ rising to about 1 V, after which it can increase only very slowly. This means that the interior light stays on, although its brightness will slowly decrease.

At a certain level of potential across S₁, transistor T₄ switches on, which results in the drive to T₂ becoming zero, and T₂



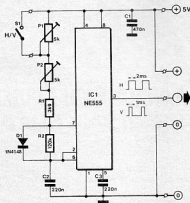
884008-10

T₂ and T₁ switch off. The interior light will then go out very quickly. The delay in the light going out after the car door is closed is preset by P₁, although it is also affected by the value of C. The larger this value, the longer the delay and the smaller the variation in the brightness of L₁. After the light has gone out, the circuit no longer draws current.

0 1

POLAROTOR CONTROL

The polarization of satellite TV signals is defined as horizontal (H) or vertical (V) with respect to the equator below the subsatellite point, and not, as is often wrongly assumed, with respect to the horizon on earth. Depending on the location of the receiving system on earth and the satellite's geosynchronous position, a horizontally polarized signal may have some offset with respect to the horizon. As a rule of thumb, the lower the dish elevation for a particular satellite, the greater this polarization offset angle. The difference between horizontal and vertical is, however, always 90°. Most commercially available polarization rotation units (*polarotors*) used for selecting between horizontally and vertically polarized transponders on board a TV satellite incorporate a small servo motor whose direction of travel is controlled automatically by the channel selection circuitry in the indoor unit, or simply by a switch. The servo motor rotates an angled probe fitted in a PTFE bush in the waveguide flange that is secured onto the feed horn. This probe can be rotated over 90°, and re-transmits the received 11 GHz satellite signal by means of a $\frac{1}{4}\lambda$ probe fitted vertically in the waveguide that connects to the LNB. The polarotor assembly is fitted permanently between the feed horn and the LNB input, and is connected to the indoor unit via a length of 3-wire cable, which runs in parallel with the downlead coax. A polarization selection switch, S₁, is provided on the Indoor Unit for Satellite TV Reception (1), but not the accompanying driver circuit, which is given here. The polarotor control is an astable multivibrator that determines the direction of travel of the servo motor by supplying output pulses with a duration of 1 ms (V) or 2 ms (H) (typical values). When horizontal/vertical (H/V) switch S₁ is closed, P₁ is short-circuited, so that IC₁ supplies pulses with a duration of 1 ms. In the polarotor assembly, a com-



combination of a potentiometer coupled to the motor spindle and an electronic circuit is used for comparing the duration of the received control pulses with that of the internally generated spindle positioning pulses, and actuates the motor until the pulses are of equal duration. The microwave probe in the feed horn waveguide is then positioned vertically. Similarly, when S₁ is opened, P₁ is included in the R-C timing circuit of IC₁. Due to the higher total resistance, IC₁ supplies pulses with a duration of about

2 ms, so that the waveguide probe is rotated over 90° for reception of horizontally polarized signals.

The control circuit and the servo motor are powered from a regulated 5 V supply, which is simple to construct around a Type 7805 3-pin integrated regulator. In the case of the above mentioned Indoor Unit, the input of the 7805 can be connected to the input of IC₁ (Type 7812 on the vision/sound/PSU board). Due care should be taken, however, not to overload the mains transformer, T₁, or optional series resistor R_x, since the maximum current consumption of a blocked polarotor motor is typically about 300 mA. In some cases, it may be necessary to fit a relatively large electrolytic decoupling capacitor direct across the supply terminals of the servo motor. The value of this capacitor depends on the actual current consumption of the motor, but 470 µF should work satisfactorily in most cases. It is recommended to use fairly stout wire for connecting the polarotor to the control circuit.

The circuit is simple to set up: connect an oscilloscope to the pulse output line, and adjust P₁ and P₂ for correct duration of the rectangular output pulses (note that the settings interact). Open the available polarotor to check that the travel of the probe covers the full range of 90°. In the absence of an oscilloscope, P₁ and P₂ are adjusted until the servo motor works reliably over the full range in both directions of travel. Polarization offset correction can be achieved by adjusting the presets accordingly. Continuous adjustment of the probe position (*skew*) for satellite reception experiments can be achieved by using potentiometers instead of presets in positions P₁ and P₂. Current consumption of the control circuit is about 7 mA.

PROGRAMMABLE VOLTAGE SOURCE

A number of appliances, such as an EPROM programmer, require a supply voltage that can be switched to a variety of levels. The proposed circuit enables the user to do so between 5 V and 21 V. As soon as the switching transistor conducts, R_2 is connected in parallel with R_1 . This lowers the total resistance between the 'adj' pin of the LM317 and earth, and consequently the output voltage.

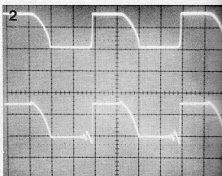
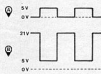
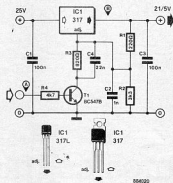
It is possible to add a number of switching transistors and associated resistors and capacitor to the circuit to increase the number of available output voltage levels.

The level of the output voltage depends on the ratio between R_1 and the resulting value of R_2 in parallel with R_3 . The p.d. across R_1 is always 1.2 V. Thus,

$$U_o = \left[1 + \frac{R_2/R_3}{R_1}\right] \text{ volts}$$

Capacitors C_1 and C_3 serve to optimize the switching behaviour of the circuit. The value of these components has to be established with the aid of a square-wave generator and an oscilloscope. The effect of these capacitors on the

1



output voltage is shown in the photograph.

An additional advantage of the use of an integrated voltage regulator is that this affords a means of current limiting. If, for instance, the 'L' type of this IC is used, current limiting starts at about 100 mA. This magnitude of current will be more than adequate for most EPROMs.

Finally, it is possible to replace T_1 and R_2 by a high-voltage open-collector TTL gate, such as provided by the 7407.

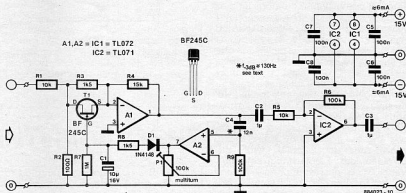
AUTOMATIC VOLUME CONTROL

The proposed AVC gives weaker components of the input signal extra amplification while ensuring that this dynamic compression is not disconcerting. It therefore eliminates those annoying differences in loudness between speech and music on radio and television.

The principle of the circuit is fairly simple. Field-effect transistor T_1 is used as a variable resistance. The value of this resistance, $R_{D(on)}$, can vary from infinity to about 150 Ω . It is in parallel with R_3 and, in conjunction with R_4 , determines the gain of A_1 . Without the effect of the FET, the gain of A_1 is about 20 dB.

Opamp A_2 is connected as a straightforward amplifier, whose gain may be varied by P . The negative part of the output signal of A_2 is connected to the gate of T_1 via a rectifier formed by D_1 , C_1 , R_7 , and R_8 . Resistor R_8 ensures that the switching of T_1 happens gradually. This means that it takes a short time before T_1 operates; in other words, momentary differences in input level do not affect the overall gain. The reduction in gain also takes place gradually, because C_1 has to discharge via R_7 . Because the resistance of T_1 is influenced by the drain-source voltage, U_{DS} ,

1



the signal level has to be kept as low as possible (thanks to the use of opamps, there is no direct voltage across the drain-source junction). An attenuator, R_1 - R_2 , which gives an attenuation of 40 dB, is therefore provided at the input. This enables signals of up to 1 V r.m.s. to

be processed with a distortion of not greater than 0.6%. With an input of 1 V r.m.s., the signal-to-noise ratio is about 70 dB.

The amplification in A_1 and A_2 compensates the losses in the attenuator: the total gain of the circuit, with T_1 switched

Parts list

Resistors ($\pm 5\%$):

R1;R5 = 10K
R2 = 100R
R3;R8 = 1K5
R4 = 15K
R6;R9 = 100K
R7 = 1M0
P1 = 100K multiturn preset

Capacitors:

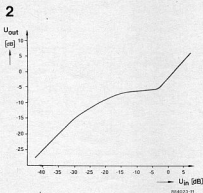
C1 = 10 μ ; 16 V
C2,C3 = 1 μ 0; MKT
C4 = 12n
C5...C8 incl. = 100n

Semiconductors:

D1 = 1N4148
T1 = BF245C
IC1 = TL072
IC2 = TL071

Miscellaneous:

PCB Type 884023



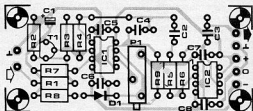
off, is 0 dB.

Network R₆C₄ is a high-pass filter which ensures that strong bass signals do not affect the control function to much extent. The cross-over point may be altered to personal taste.

Signals at a level below that set by P₁ are amplified by a factor of up to 6.9 (gain = 17 dB). Fig. 2 shows the relation between input and output levels.

The circuit needs a supply voltage of ± 15 V and draws a current of about 6 mA.

3



0 1 8

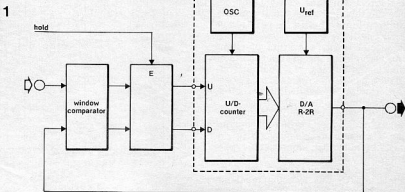
SAMPLE & HOLD FOR ANALOGUE SIGNALS

Conventional analogue sample and hold circuits are notorious for their tendency to drift, a phenomenon unknown in digital memories. It is, therefore, interesting to study the use of a digital memory element for storing an analogue signal.

The present circuit is based on intermediate storage of digitized analogue information, and therefore requires an analogue-to-digital converter (ADC) at the input, and a digital-to-analogue converter (DAC) at the output. Unfortunately, DACs and ADCs are typically expensive components, and the present circuit is therefore set up with a DAC only, driven by an up/down counter—see Fig. 1. The counter is essentially an ADC, since the output voltage of the R-2R based DAC is continuously compared to the input voltage with the aid of a window comparator. The error signal produced by the comparator arranges for the counter to count up or down, depending on the magnitude of the difference between the input and output voltage. The up/down counter is corrected until the input and output voltage are equal. The digitized result of the A-D conversion is

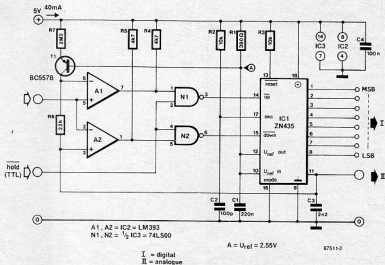
available at the counter outputs. The extensions for converting the basic set-up into a sample & hold circuit are relatively simple. The current count is

retained by activating the **HOLD** input, which enables halting the U/D counter. Evidently, the counter state is not subject to drift, so that the analogue output



signal is available unaffected for as long as the circuit is powered. The converter used here is the Type ZN435 ADC/DAC from Ferranti. This chip contains everything shown in the dashed box of Fig. 1. With reference to the practical circuit diagram, Fig. 2, the internal voltage reference and the oscillator are adjusted with R_1-C_1 and R_2-C_2 respectively. The latter are dimensioned for 400 kHz, i.e., nearly the maximum oscillator operating frequency. The internal counter is controlled via inputs up, down and mode. The logic level applied to the mode input determines whether the counter continues or halts upon reaching state 0 or the maximum value, 255. In the present application, the counter is halted. Gates N_1 and N_2 are added to enable blocking the U/D counter. Opamps A_1, A_2 form the window comparator. Current source T_1-R_7 and R_8 arrange for the toggle threshold of A_1 to be 20 mV higher than that of A_2 . This off-set creates the window, or inactive span, needed to suppress oscillation of the counter's LS bit, and to prevent unwanted effects arising from the comparators' offset voltages. Decoupling capacitor C_3 is fitted for suppressing spikes that occur during state changes on the counter outputs. The

2



conversion time of this design is about 640 μs , as determined by the oscillator frequency (400 kHz), the resolution (8 bits) and the input voltage change (2.55 V_{pp} max.). This corresponds to a

slew rate of 4 mV/ μs at the input. Finally, bear in mind that the output impedance (IC_1 , pin 11) is relatively high at about 4 k Ω .

LOW-FREQUENCY LC OSCILLATOR

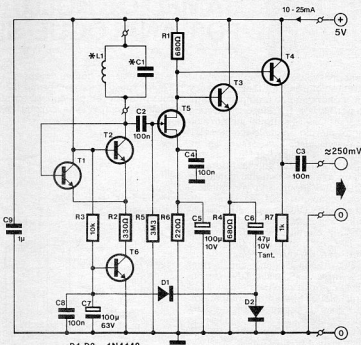
It is not always appreciated that LC circuits may be used for generating low frequencies. The proposed circuit, provided it uses good-quality components, can be used for frequencies down to 150 Hz, and possibly even slightly lower. The oscillator proper consists of T_1 and T_2 with the LC circuit connected in the collector circuit of T_2 . The amplification is set with the aid of the current source around T_2 .

The voltage across the tuned circuit is tapped at high impedance and amplified by T_3 . The output of this FET is buffered by T_4 and then rectified by D_1-D_2 . The resulting direct voltage is used for driving the current source. Since the rectified voltage still contains a ripple, a further buffer, T_6 , is added at the output of the circuit.

The circuit draws a current of about 20 mA, which can rise to about 25 mA at higher frequencies. Its output impedance has been kept as low as possible to render the bandwidth of the oscillator as broad as possible.

Fairly high values of inductance may be used, provided the Q is of a reasonable value. Capacitor values may go up to 10 μF , but note that electrolytic types can not be used.

In the prototype, L_1 had a value of 150 mH and C_1 was 6 μF ; the resulting frequency was 150 Hz. The oscillator generates pure sine waves up to 7 to



D1, D2 = 1N4148
T1...T4 = BF199
T5 = BF256B
T6 = BC550C

* see text

984070 - 10

8 MHz and operates well up to about 30 MHz; the washshape is then no longer a pure sine wave, however. Operation at still higher frequencies is possible, but the output level then drops from the nominal 250 mV.

The circuit may be used to measure unknown capacitors or inductors, provided the other component in the LC network is known, with the aid of the formula $f=1/2\pi\sqrt{LC}$.

able, but the output level then drops from the nominal 250 mV. The circuit may be used to measure unknown capacitors or inductors, provided the other component in the LC network is known, with the aid of the formula $f=1/2\pi\sqrt{LC}$.

0 2

SINGLE-CHIP 150 W AF POWER AMPLIFIER

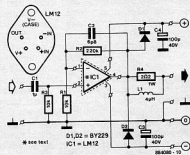
The Type LM12 operational amplifier from National Semiconductor has at least one remarkable characteristic: its huge output current capability of about 10 A. The chip is housed in a 4-pin TO-3 enclosure; can handle peak powers up to 800 W, and has extensive internal protective circuits to prevent damage caused by current and voltage overloading, or by overheating. Peak operating temperature of the on-chip power output transistors is measured for controlling a limiter that forms part of a so-called *dynamic safe area protection circuit*. The power output stage is not connected to the relevant pin until the supply voltage exceeds 14 V (± 7 V). Output disconnection is automatic when the chip temperature rises above 150 °C. It is possible to connect LM12s in parallel, or in a bridge configuration, for very high power applications (voltage regulators, automotive drivers, stepper motor or power servo controllers, etc.). The present application discusses the use of the LM12 in a high-power AF amplifier.

The circuit diagram shows two clamping diodes at the chip output. These prevent the output voltage swing exceeding the supply voltage when the push-pull output stage in the chip is overdriven, and the output load is mainly inductive. The diodes also protect the chip when the output is short-circuited to the positive or negative supply rail. The Type LM12CL or LM12C may be used with supplies up to ± 30 V or ± 40 V respectively.

Input bias currents are compensated because the circuit is laid out for virtually equal impedance at the inverting and non-inverting input of the opamp. Input offset is 20 mV maximum. If this is considered too high, it can be cancelled completely by applying an appropriate offset compensation voltage to one of the inputs (use a well-decoupled potential divider). Output offset voltage in a number of prototypes without compensation circuitry was between 100 and 200 mV.

Half-power (-3 dB) bandwidth of the amplifier is 16 Hz to 40 kHz; distortion is approximately 0.02% at $P_o=1$ W and $R_L=2\ \Omega$ or $4\ \Omega$. At full drive, distortion increases to 0.05% ($U_b=\pm 30$ V; $R_L=4\ \Omega$). Maximum current is supplied to a $2\ \Omega$ load, but distortion then increases to 0.1%.

Quiescent current of the amplifier is between 65 and 100 mA. Inductor L_1 is wound as 40 turns of 1 mm dia. enamelled copper wire on power resistor R_4 . It serves mainly to ensure correct operation of the feedback amplifier with capacitive loads, such as large voice coils and loudspeaker cross-over filters. It will be clear that the supply for the amplifier must be capable of handling the peak current requirement of the LM12. For the LM12CL, it is recommended to use a toroid mains transformer with a 2×22 V secondary winding (150 W can then be supplied to a $2\ \Omega$ load only). Depending on the application and the output power required, the transformer's secondary



should be rated between 7 and about 12 A. Smoothing capacitors in the symmetrical supply should be not smaller than 20,000 μ F on each rail. Finally, IC₁ should be bolted on to a large heat-sink, from which it is electrically insulated.

Parts list

Resistors ($\pm 5\%$):

R₁, R₃ = 10K
R₂ = 220K
R₄ = 2R₂; 4 W

Capacitors:

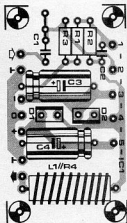
C₁ = 1 μ 0; MKT
C₂ = 6p8
C₃, C₄ = 100 μ ; 40 V

Semiconductors:

D₁, D₂ = BY229
IC₁ = LM12 (National Semiconductor)

Miscellaneous:

Large heat-sink for IC₁ (≤ 1.5 °C).
Insulating material for IC₁.
PCB Type 884080



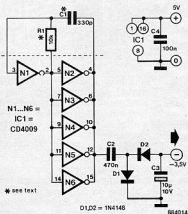
AUXILIARY NEGATIVE-VOLTAGE SOURCE

Many circuits require, apart from the usual positive voltage source, a negative supply from which only a small current is drawn. In such cases, a mains transformer with twin secondary winding would be a rather too costly solution.

The circuit proposed here generates a negative potential from a positive supply. This supply may provide between 5 and 15 V. If the current drawn from this supply is smaller than 1 mA, the level of the negative voltage generated lies about 1.5 V below that of the supply voltage. Thus, if the supply is 5 V, the negative potential is -3.5 V. When a current of 2 mA is drawn from the supply, the difference between the two voltages increases to about 2.5 V. Operation of the circuit is fairly simple. Gate N_1 , in conjunction with parallel-

connected gates N_2 to N_6 incl., functions as a square-wave generator with buffered output. The peak-to-peak value of the square-wave voltage is, due to the use of CMOS gates, very nearly equal to the supply voltage. Rectifier D_1 - D_2 ensures that the alternating voltage is converted into a steady negative one. If a clock frequency between 10 and 50 kHz is available, this can be applied to the input of N_1 . Capacitor C_1 and R_1 are then not required.

(Intersil application)



SINGLE-CHIP SOLID-STATE RELAY

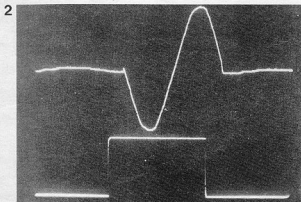
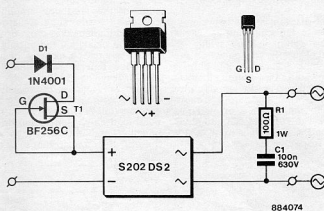
Light-duty (25 to 600 W) solid-state relays have recently been introduced on the market by Sharp. These small and compact devices switch accurately at the zero-crossing and provide the required electrical separation. The photograph shows clearly that switching occurs exactly at the zero-crossing. This prevents switch-on currents of lamps becoming large and so extends the life of the lamp.

The breakdown voltage of the triac section is 2 kV and the pins are on a 0.1 in grid.

The relay requires an energizing current of 10 mA at 1.4 V, but with inductive loads about 25 mA is necessary.

The additional components shown in the diagram make the relay more universally usable. Diode D_1 prevents the IC being damaged if the input is connected incorrectly. Transistor T_1 sets the trigger current to precisely 10 mA. The RC network at the output protects the triac from sharp voltage peaks.

The IC may be used without heat sink to switch currents up to 1 A. For switching larger currents, up to a maximum of 3 A, a 2mm thick 100x100 mm heat sink should be used.



This timer can be set to count a maximum of 60 hours. It also allows an interval to be set. When this interval is reached, a buzzer sounds.

The larger part of the circuit is contained in an Intersil Type ICM7217 four-digit CMOS up/down counter and display.

Circuit IC₃ is the clock that generates a square wave with a period of 1 s. The clock signal is available at pin 3 (Q13). The clock signal may be divided by 60 in IC₄ if it is required to time more than 1 hour.

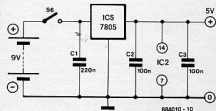
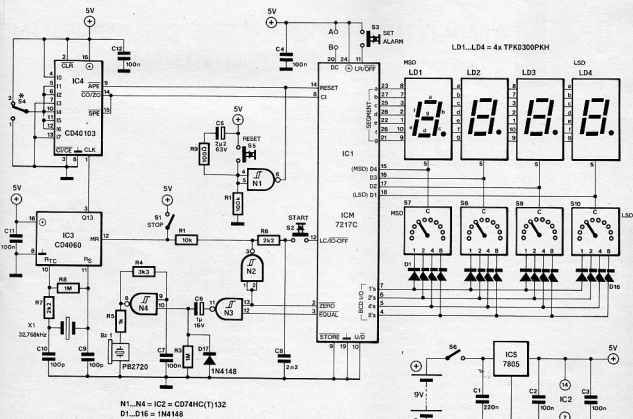
When S₆ is closed, the supply is switched on and IC₁ is reset via R₅ and C₅. The position of S₄ determines whether minutes or seconds are counted: maximum 59 h 59 min (pos 2) or 59 min 59 sec (pos 1).

If, for instance, a total time of 35 min with an interval at 20 min is to be counted, S₄ is set to position 1. Thumb wheel switches S₇ to S₁₀ are then set for a display reading of 20.00. Briefly pressing S₅ stores this setting in the memory of IC₁. Then S₇ to S₁₀ are set for a display reading of 35.00. During these settings, S₁ should be open. Pressing S₂ causes the buzzer briefly sounds (energized via N₃ and N₄). The timer may then be stopped by closing S₁. When S₁ is opened again, the timer restarts the down count to 00.00. When that reading is reached, the buzzer sounds briefly again. Note that at any time during the count down the timer may be stopped by closing S₁.

The timer is reset with S₅; when that happens, the buzzer sounds briefly and the display reads 00.00. The set count down period of 35 min is, however, retained in the memory until a new period is programmed.

The current drawn by the timer, including the displays, is about 100 mA. If a battery supply is used, it is possible to switch off the displays when the timer is counting by adding a switch (with single break contact) between points A and B. This switch enables the display to be read briefly. With the displays switched off, the current drawn is of the order of only 4 mA.

Do not set the thumb wheel switches to readings greater than 59.59, because the timer will then no longer count correctly.



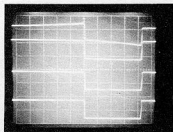
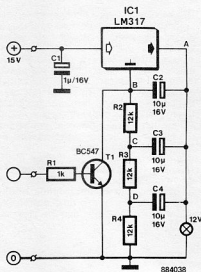
FLASHING LIGHT

This is a rather unusual application of the Type 317 voltage regulator. With only a handful of external components, it can be used for flashing a small 12 V lamp. The output voltage is not stabilized by the circuit; it is simply a few volts lower than the input voltage. The 317 is capable of delivering more than 1 A.

The circuit automatically limits the switch-on current, so that lamp life is considerably extended. The waveforms at the four major points in the circuit are shown in the accompanying photograph.

The component values given result in a flash frequency of about 4 Hz. Flashing can be stopped by driving T_1 with a voltage of more than +1 V.

Source: *Lambda Power Supply Handbook*



AMPLITUDE-MODULATED CALIBRATION GENERATOR

A calibration generator is used for quickly checking receiver operation. The design shown here generates RF signals (*markers*) at 1 MHz intervals over a frequency extending up to about 2 GHz. These signals can be amplitude-modulated by driving T_1 with a sine wave generator.

A stable 2 MHz oscillator is set up around X_1 and T_1 . MOSFET T_2 functions as a digital buffer for clocking bistable/divider FF1. Pulses at the output of FF1 have a frequency of 1 MHz and a width of only 12 ns, which is obtained by FF2 clearing itself after output Q has gone low. The pulses drive T_3 into saturation. This SHF transistor consequently produces a wide spectrum of harmonics, and its class C setting causes it to function as a frequency multiplier. The collector current can be modulated via series transistor T_4 . Since the two sidebands generated in the process of amplitude modulation are offset from the carrier by the modulation frequency, AM can be used to generate signals at frequencies in between the markers. Example: modulating the calibration generator with a 204 kHz sine wave gives two additional frequencies adjacent to the marker at, say, 1120 MHz: $1120 - 0.204 = 1119.796$ MHz and $1120 + 0.204 = 1120.204$ MHz. Hence, a continuous tuning range from 1 MHz to

2 GHz is obtained when the sine wave generator output frequency is adjustable between 500 kHz and 1 MHz. The measured amplitudes of four markers produced by the calibration generator show that available output levels fall with increasing frequency:

$f = 100$ MHz: $P_0 = -25$ dBm

$f = 400$ MHz: $P_0 = -45$ dBm

$f = 1.0$ GHz: $P_0 = -55$ dBm

$f = 1.8$ GHz: $P_0 = -70$ dBm

Note: 0 dBm = 1 mW in 50 Ω .

Construction of the calibration generator is straightforward even for those with limited experience in building RF circuits. It is essential that close-tolerance (2.5 or 5%) polystyrene capacitors be used in positions C_1 , C_2 and C_4 . Inductor L_1 is wound as 3 turns 0.2 or 0.3 mm dia. enamelled copper wire through a small (3 to 5 mm long) ferrite bead. Be careful to avoid short-circuits between the windings as the enamel coating may be damaged when the wire is pulled through the hole in the bead.

The calibration generator is powered from a 6 V battery pack so that it can be used as a portable test instrument. Current consumption is less than 20 mA.

Parts list

Resistors ($\pm 5\%$):

$R_1 = 2k2$

$R_2 = 33k$

$R_3 = 47k$

$R_4 = 1k0$ $R_5, R_6, R_7 = 22k$

$R_8 = 56R$

Capacitors:

$C_1 = 470p$

$C_2 = 22p$

$C_3 = 390p$

$C_4 = 1n0$

$C_5 = 180p$

$C_6 = 22n$

$C_7 = 4p7$

$C_8 = 390p$

$C_9 = 4u7, 16V$

$C_{10} = 10n$ ceramic

* Polystyrene (Siemens Styroflex); tolerance $\leq 5\%$.

Inductor:

$L_1 =$ see text.

Semiconductors:

$D_1 = 1N4148$

$IC_1 = 74HCT74$

$T_1 = BF494$

$T_2 = BF981$ or $BF982$

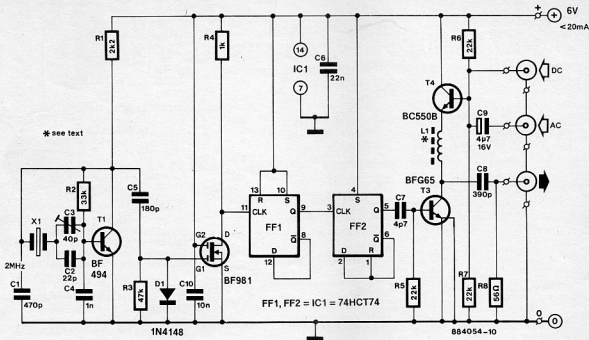
$T_3 = BFG65$ (Philips/Mullard)

$T_4 = BC550B$

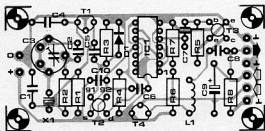
Miscellaneous:

$X_1 = 2$ MHz quartz crystal; 30pF parallel resonance.

PCB Type 884054;



2



0 2 6 SIMPLE PHONO PREAMPLIFIER

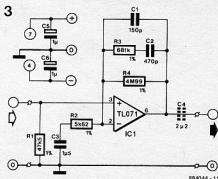
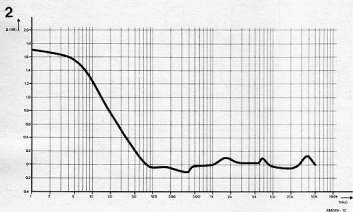
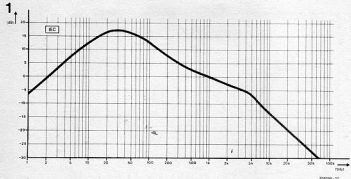
This circuit shows that a preamplifier for magneto-dynamic cartridges can be relatively simple without seriously compromising compliance to the IEC standard in respect of frequency response. Compared to the RIAA standard, the IEC frequency curve has an additional roll-off point at 20 Hz—see Fig. 1. The circuit diagram of Fig. 3 shows that input and output of the preamplifier based around the Type TL071 operational amplifier are direct coupled, making it possible to accurately define the previously mentioned roll-off by means of network R_2 - C_3 . Output offset

of the preamplifier is about 3 mV. Output capacitor C_4 can be fitted if this offset voltage can not be handled by the input of the line or power amplifier.

For optimum compliance with the IEC frequency curve it is recommended to use close tolerance polystyrene (Siemens *Styroflex*) capacitors in positions C_1 and C_2 , and an MKT capacitor in position C_3 . Resistors are preferably high-stability metal film types from the E48 or E96 series, although less expensive and commonly available types from the E12 series may also be used with reasonable results when selected for

the required resistance with the aid of a digital ohmmeter. It was with this in mind that R_2 has been dimensioned at 5K62 (E12: 5K6). This value gives a roll-off at 18.9 Hz instead of the required 20.0 Hz, so that the low-frequency response (up to 50 Hz) of the preamplifier deviates slightly from the IEC curve. The deviation, Δ , of the amplification with respect to the values set by the IEC is shown as a function of frequency in Fig. 2.

A prototype of the preamplifier built with the component values given in the circuit diagram gave the following test



results: voltage gain 39 dB at 1 kHz; signal-to-noise ratio greater than 70 dB at 1 kHz and 100 mV output signal (up to 80 Hz; greater than 60 dB). The input was connected to a test generator which supplied 1 mV_{rms} at an output impedance of 1 kΩ.

The circuit should be fed from a well-regulated symmetrical supply (preferably ±15 V, but ±12 V or ±8 V should also work). A suitable supply is simple to build around two integrated regulators such as the 78Lxx and 79Lxx types, which can step down supply voltages already available in the line or power amplifier. Current consumption of the preamplifier is only 2 mA.

0 2 7

ALTERNATING CURRENT SOURCE

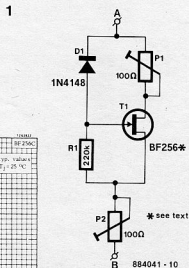
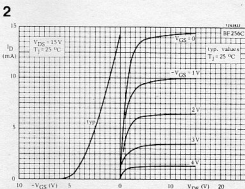
One of the less known properties of field effect transistors is that some of these are electrically symmetrical, which means that the drain and source may be interchanged under certain conditions. This circuit is based on this phenomenon, and feeds a constant alternating current through P₂ when connected to an alternating voltage source.

The operation is best explained with reference to the curves of Fig. 2, and by assuming that a sinusoidal voltage is applied to terminals A and B.

When the drain of T₁ is negative with respect to the source, D₁ blocks, and forms a resistance that is considerably higher than that of R₁. This has virtually no voltage on it, so that V_{GS} = 0 V. This means that I_D is constant at about 19 mA when V_{DS} > 8 V (see Fig. 2a). It should be noted that the curves and values of I_D and V_{DS} are typical, and may deviate depending on the FET used (A, B or C suffix). When the drain of T₁ is positive with respect to the source, D₁ conducts. Provided P₁ is adjusted such that the voltage on it equals V_N, there is, again,

no voltage difference between the gate and the source, so that the FET functions as a current source as shown above.

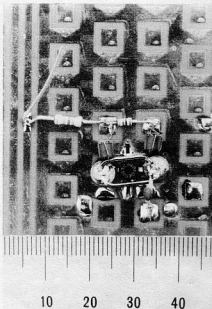
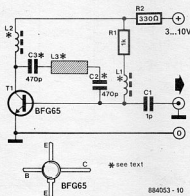
The constant alternating current supplied by the circuit can be defined by fitting small resistors in the drain and source lines, so that V_{GS} is set to values other than 0 V. The input voltage range of the current source is 6 V_{rms} to 18 V_{rms}.



VOLTAGE-CONTROLLED SHF OSCILLATOR

This oscillator supplies an output level between -10 dBm and $+3$ dBm, and can be tuned between 1250 MHz and 1800 MHz simply by varying the supply voltage. Operation of the circuit is based on the fact that the transition frequency, f_t , of the BFG65 is reduced when the collector current rises above 10 mA. The oscillation frequency is also determined by the physical layout of inductor L_2 , which is a strip line made from two parallel running lengths of 1 mm dia. silver plated wire. The length is established experimentally, starting from 13 mm. Chokes L_1 and L_2 are 3 turns of thin enamelled copper wire (dia. 0.2 or 0.3 mm) through a small (3 mm) ferrite bead. Capacitors C_2 and C_3 are leadless ceramic types (rectangular or disc).

The SHF test oscillator is ideal for quickly finding the maximum usable input frequency of, for instance, a frequency meter specified to reach up to 1.2 GHz. In addition, it can be used for testing RF input sections in indoor units for satellite TV reception.



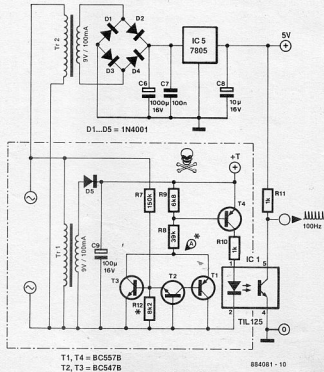
COMPUTER-DRIVEN POWER CONTROLLER

This circuit enables a computer to control the power supplied to a mains operated device (lamp, heater, drill, etc.) in 255 steps. Variation of power is achieved by controlling the voltage supplied to the load (R_L in the circuit diagram of Fig. 2). A conventional power regulator is used here, composed of a triac and a simple associated circuit to control the phase angle at which the triac is triggered.

The power supply and mains trigger circuitry are shown in Fig. 1. The circuit around $T_1 \dots T_4$ incl. IC_1 is a zero-crossing detector which produces an active high pulse every time the mains voltage is zero. Opto-coupler IC_1 insulates the rest of the circuit from the mains.

With reference to Fig. 2, Schmitt-trigger N_1 inverts the zero-crossing pulses, causing 8-bit binary down counter IC_2 to load the 8-bit word applied to counter preset (jam) inputs $J_0 \dots J_7$. The counter is decremented one count by each clock pulse supplied by oscillator N_2 . When counter state nought is reached, output ZD goes low, and N_3 inhibits further clocking of IC_2 . Simultaneously, N_4 produces an output pulse, so that T_5 conducts and fires the triac.

As the triac is only fired when IC_2 counts to zero, the instant at which this happens depends on the value of the 8-



T1, T4 = BC557B
T2, T3 = BC547B

* see text

bit control word received from a computer. Hence, the time that lapses between the zero crossing instant and the triac firing instant is a function of the magnitude of the control word. The greater the 8-bit word, the greater the phase angle, and the less power is delivered to the load.

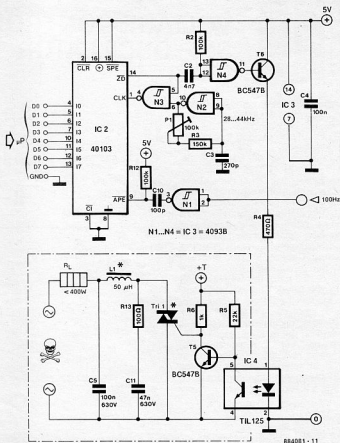
Inductor L_1 suppresses RF interference caused by the triac, and should be able to carry at least 5 A. The triac in this circuit can be a TIC206D (4 A) or a TIC216D (5 A). Other types may be used if these are known to trigger at a gate current of less than 10 mA. The value of R_{12} is determined empirically, and should be as high as possible without causing the disappearance, on point A, of pulses with an amplitude of 5 V_p.

The only adjustment required is that of P_1 . If complete switching off of the load is required, this preset is adjusted for 0 V indicated by an AC voltmeter connected instead of the load, with data FF_H (255₁₀) written to the power controller. If regulation from 0 V onwards is not desired, P_1 is adjusted so that the meter reads the required minimum voltage. When writing programmes for the power controller, it should be remembered that the power delivered to the load is an inverse function of the value written into the computer's output port.

Safety precautions:

The shaded parts in the circuit diagrams are operated at mains potential, and must never be touched while the unit is being powered. Great attention should be paid to proper insulation in the selecting and mounting of the parts within the shaded areas. It is strongly recommended to bend the pins of the optocoupler away from the package to ensure an insulation distance of at least 6 mm.

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Finally, it should be noted that the circuit may not operate correctly with loads below about 40 W, and that writing 00H to the data input has the

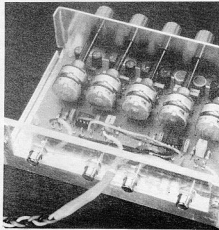
same result as FF_H, namely minimum voltage applied to the load. Regulation effectively starts with data 01H.

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FIVE-BAND STEREO GRAPHIC EQUALIZER

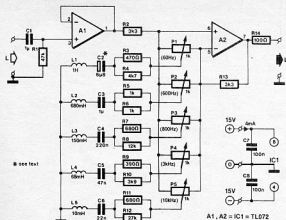
This design of a stereo equalizer is fairly unusual because it is based on inductive feedback. In theory, the feedback circuit around opamp A₁ would provide 15 dB amplification or attenuation of each frequency range, but in practice only about 13 dB is attainable owing to losses in the inductors. A virtually flat frequency response is obtained when all five potentiometers P_1 to P_5 are set to the centre position (0 dB). Total control range of the unit is about 33 dB.

The TL072 dual opamp in each channel is a trade-off between cost and performance in respect of noise and distortion. Set to 0 dB gain, a prototype of the equalizer produced 0.04% distortion at an input signal of 1 kHz, 1 V, and 0.13% at 5 and 10 kHz. Distortion is highest when the test frequency lies within one band that is fully attenuated while the

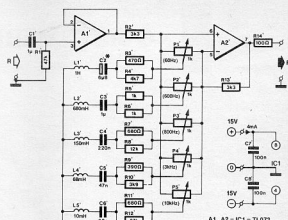


other four are set to maximum gain. In this condition, test measurements resulted in a maximum distortion of 1.5%, which is certainly tolerable given the simplicity of the circuit. Signal-to-noise ratio is greater than 90 dB at an input amplitude of 1 V.

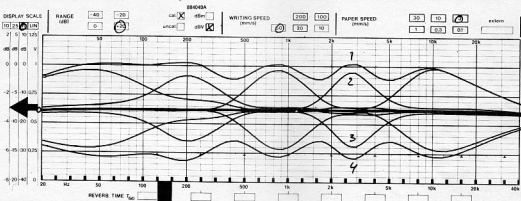
The frequency response curves were obtained with the following settings: curve 1: all controls set to maximum; curve 2: 4 controls set to 0 dB, and 1 to maximum; curve 3: 4 controls set to 0 dB, and 1 to minimum; curve 4: all controls set to minimum. Due attention should be paid to the DC resistance of the inductors. The total resistance of the inductor and series resistors in each feedback network should remain 680 Ω, so that R_3 to R_{12} incl. may have to be dimensioned dif-



A1, A2 = IC1 = TL072



A1, A2 = IC1 = TL072



Parts list

Resistors ($\pm 5\%$):

- R1; R1' = 47K
 R2; R2'; R13; R13' = 3K3
 R14; R14' = 100R
 P1... P6 Incl. = 1K Ω stereo linear potentiometer for PCB mounting.
 • The following values are given as guidance only (see text):
 R3; R3' = 470R
 R4; R4' = 4K7
 R5; R5' = 1K Ω
 R6; R6'; R6; R6' = 1K Ω
 R7; R7'; R11; R11' = 680R
 R8; R8' = 12K
 R9; R9' = 390R
 R10; R10' = 3K9
 R12; R12' = 27K

Capacitors:

- C1; C1' = 1H, e.g. Toko Type 293LY-105
 [Circuit stock no. 34-10513].
 C2; C2' = 6 μ 8, bead tantalum
 C4; C4' = 220n
 C5; C5' = 47n
 C6; C6' = 22n
 C7; C7'; C8; C8' = 100n

Inductors:

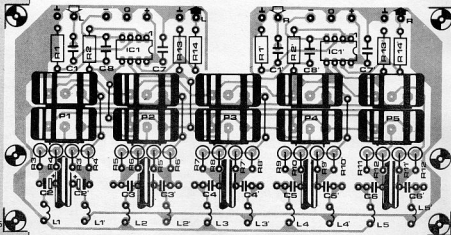
- L1; L1' = 1H, e.g. Toko Type 293LY-105
 [Circuit stock no. 34-10513].
 L2; L2' = 680 mH, e.g. Toko Type 293LY-684
 [Circuit stock no. 34-68413].
 L3; L3' = 150 mH, e.g. Toko Type 293LY-154
 [Circuit stock no. 34-15413].
 L4; L4' = 68 mH, e.g. Toko Type 181LY-683
 [Circuit stock no. 34-68302].
 L5; L5' = 10 mH, e.g. Toko Type 181LY-103
 [Circuit stock no. 34-10302].

Semiconductors:

- IC1; IC1' = TL072

Miscellaneous:

- PCB Type 884049



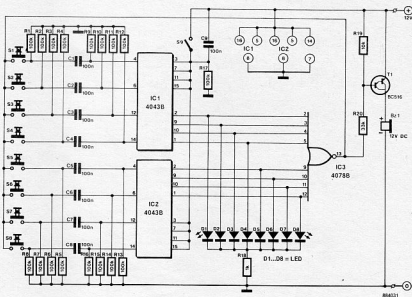
ferently than shown in the circuit diagram. Always measure the resistance of the inductors used, and then calculate the value of the resistor required to obtain a total of 680 Ω . Example: a Type 293LY-154 150 mH inductor from Toko was found to have a DC resistance of 37 Ω , requiring a series resistor of 680 - 37 = 643 Ω . This value is

approximated with the aid of a 680 Ω and 12 k Ω resistor in parallel (R7-R8 in the circuit diagram). Ferrite-encapsulated inductors are recommended to reduce magnetic coupling, and to keep crosstalk at relatively high frequencies down to an acceptable level (< -60 dB at 10 kHz).

QUIZ TIMER

Here is a simple 'who's the first' circuit that can be used in quiz games with up to eight participants or groups of participants. The circuit indicates the first one to press his key by a glowing LED against his number or any other identification used in the quiz or game. At the same time, the circuit gives an audible indication that some key has been pressed. The RESET key enables the quiz master to restore the circuit's original state before updating the score and proceeding with the next question or assignment.

After RESET has been pressed, the eight R-S bistables in IC₁ and IC₂ are reset. The Q outputs all go logic low and, consequently, the output of IC₃ goes logic high. The circuit is now ready to be operated. For example, if S₁ is pressed first, the first bistable is set and output Q₁ goes high. The output of IC₃ pulls the common line of keys S₁...S₈ incl. logic low to prevent more bistables being set. Hence, Q₁ is the only output that is logic high. This condition is indicated by LED D₁. Simultaneously, T₁ is biased and switches on the buzzer to attract the attention of the quiz master. Capacitors C₁ to C₈ incl. prevent the bistables being set permanently if a key is kept pressed for a long time. Finally, S₉ is pressed to reset the circuit. This causes all Q outputs to be made logic low, and the common key line high, returning the circuit to its original con-



dition.

The circuit is not critical in respect of supply voltage, which is preferably the working voltage of the active piezo-buzzer (6 V or 12 V). Current consumption in the de-activated state is less than

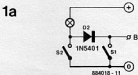
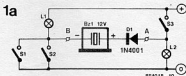
1 mA, while less than 25 mA is drawn when one of the LEDs is illuminated. The supply voltage need not be regulated, making it possible to use an inexpensive mains adapter of the DC type.

HEADLIGHTS INDICATOR

It is never advisable to leave a car's headlights on for long periods when the engine is not running. Yet, especially during the winter months, many of us inadvertently do this. The indicator described here helps to prevent you suffering the consequent and inevitable flat battery.

In its simplest form, the indicator consists of a d.c. buzzer and a diode as shown in Fig. 1a. With the headlights on (S₂ closed), the interior light (L₁) does not come on until one of the front doors is opened (when either S₁ or S₂ closes). At the same time, the buzzer is energized and sounds. Either closing the door or switching off the headlights (S₂) turns the buzzer off.

The diode in series with the buzzer is necessary because B is normally at +12 V via L₁ and A at ground via the headlights (L₂—only one shown here).



The buzzer should then not sound, of course.

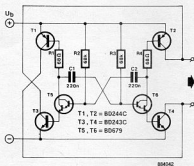
A slight modification to the circuit, enabling it to operate only on the switch in the driver's door, is shown in Fig. 1b (where it is assumed that S₁ is the relevant switch).

The buzzer draws a current of only about 10 mA when energized.

POWER MULTIVIBRATOR

This simple multivibrator circuit is remarkable for its high efficiency and ability to drive relatively heavy loads. The circuit supplies a symmetrical rectangular signal that floats with respect to the supply voltage. An astable multivibrator is formed by T_5 , T_6 , R_1 , R_2 , C_1 and C_2 . The collector currents of T_5 and T_6 drive T_1 and T_2 respectively, while the emitter currents drive T_3 and T_4 respectively. Current limiting may be dimensioned to requirement by changing R_1 . It should be noted, however, that the transistors may carry relatively high currents. Their current amplification, h_{FE} , is, therefore, fairly low, so that the current limit point can be approximated with $h_{FE_{max}}(U_b - 1.4)/R_1$. With $R_1 = 68 \Omega$ as shown in the circuit diagram, the multivibrator can be used for switching loads up to about 3 A.

Output frequency of the oscillator is approximated by $0.7/(R_2 C)$, and is about 53 Hz with $R_2 = 68 k\Omega$, $C = C_1 = C_2 = 220 nF$ and $U_b = 12 V$ (14 V: 50 Hz). One of the many applications of



the power multivibrator is a battery-operated mains converter. Its outputs are then connected to the low-voltage secondary winding of a mains transformer. A prototype of the multivibrator was dimensioned for relatively high output current at 50 Hz by fitting $R_1 = 33 \Omega$; $R_2 = 2 \times 68 k\Omega$ in parallel, and $C = 2 \times 220 nF$ in parallel. Connected to a 9.5 V; 5 A mains transformer, it powered a 40 W mains bulb with a rectangular voltage of nearly 240 V_{rms}. Supply voltage and current consumption were 14 V and 6 A respectively, yielding an acceptable efficiency of about 40%. Quiescent current consumption of the circuit is determined by R_1 , and was 0.3 A in the test set-up.

When the multivibrator is used for driving an inductive load, as in the above application, each output transistor must be protected from inductive voltage peaks by two fast high-current diodes fitted in reverse across the collector and emitter terminals.

TOUCH SENSITIVE LIGHT SWITCH

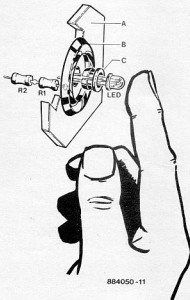
This low-cost circuit enables turning room lights on and off simply by touching a round metal sensor. The light is turned on by briefly touching the sensor, and off again by touching it slightly longer. With reference to the circuit diagram, when the sensor is briefly touched, hum and noise induced on the body are amplified by cascaded gates N_1 , N_2 and N_3 . A pulse train with a swing of nearly the supply voltage (4.7 V) and a frequency equal to that of the mains voltage (50 or 60 Hz) is applied to a bistable set up around N_4 and N_5 . C_2 is charged via D_2 , and the bistable latches in a high output state. Triac $Tri1$ is triggered via driver T_1 , so that the lamp lights.

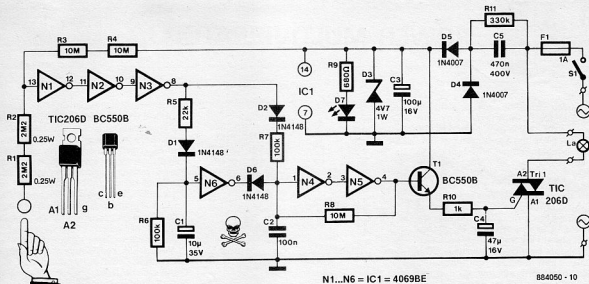
When the sensor is touched for about 2 seconds or longer, the pulse train charges C_1 via R_3 and D_1 . Inverter N_6 pulls the input of N_4 low when the voltage on C_1 is sufficiently high. Bistable N_4 - N_5 toggles and T_1 breaks the gate current for the triac, so that the lamp is turned off. The circuit also works in a relatively noise-free environment. When the user forms a relatively low resistance to ground, the input of N_1 is effectively pulled low by R_1 - R_2 , whose total resistance is low relative to

R_3 - R_4 . The effect of this on the bistable and triac circuit is similar to that outlined above.

A suggested construction of the sensor and LED is shown in the accompanying drawing. The LED is fitted in a plastic holder, and in the dark indicates the location of the light switch. The LED holder (C) is secured in the side or top panel (A) of the ABS enclosure that houses the light switch circuit. The LED is located in a thin aluminium or brass washer (B), which is connected to R_1 , and glued onto the outside surface of the plate. In the interest of safety, it is recommended to observe a minimum distance of 7 mm between the LED and R_1 . In this context, constructors are urgently advised **not** to use a metal or metallized LED holder as the sensor. Also, **never** replace R_1 and R_2 with a single 4M7 resistor.

Since this circuit is connected direct to the mains, it must be fitted in a safe and sound ABS enclosure that is impossible to open without it being deliberately damaged. Once more we advise that the presence of the mains voltage is a serious source of danger, so that the first and foremost concern of every constructor should be absolute safety.





PRINTER SHARING BOX

This simple circuit makes it possible to connect two computers to a single printer. Toggle switch S_1 selects the relevant computer by applying the appropriate logic level to the enable inputs, G , of octal bus transceivers Type 74LS641 (IC1...IC4 incl.). The direction input, DIR, of these is hard-wired to +5 V, so that the data direction is from A_n to B_n . When G is logic high, the buffers are switched to the high impedance state, so that chip outputs can be connected to form a bus structure. With this in mind it is relatively simple to see that the circuit is the electronic equivalent of a 16-way toggle switch.

Input BUSY of the non-used computer is held logic high to prevent this machine attempting to send data when the other computer is accessing the printer. The 74LS641 was chosen because it has open-collector outputs — the reason for this should be clear when it is remembered that the Centronics standard dictates the presence of pull-up resistors in the printer. The 74LS641s, of course, need pull-up resistors at the computer side also, and these are formed by resistor networks R_3 , R_4 , R_5 and R_7 .

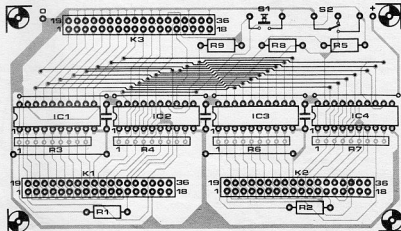
A RESET switch, S_1 , is provided to clear the printer buffer by means of an

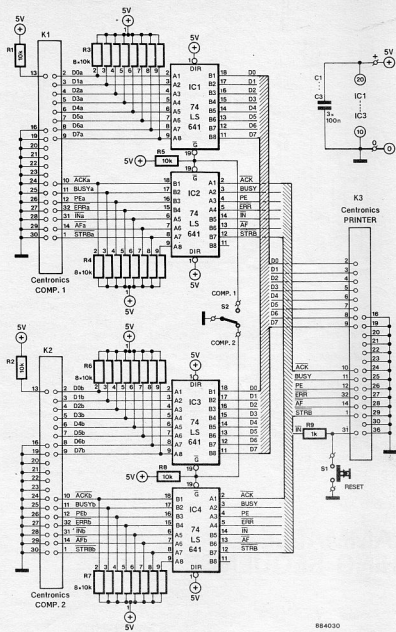
INPUT-PRIME pulse should the user find out that the wrong file is being printed. This reset option is definitely neater than switching off the printer completely to correct the error.

The circuit is conveniently powered from the 5 V supply in the printer. In most cases, this supply voltage is available on pin 18 of the 36-way Centronics input connector, but this would have to be ascertained by measuring and reference to the printer manual. It is recommended to connect +5 V to non-used pins 15 and 34 also to distribute the current over several wires in the Centronics cable. Once again, check the

Parts list

Resistors ($\pm 5\%$):
 R_1 ; R_2 ; R_5 ; R_8 = 10K
 R_3 ; R_4 ; R_6 ; R_7 = 8-way SIL resistor network
 10K
 R_9 = 1K 0 1
 Capacitors:
 C_1 ; C_2 ; C_3 = 22n
 Semiconductors:
 IC1...IC4 incl. = 74LS641
 Miscellaneous:
 S_1 = miniature toggle switch.
 S_2 = miniature toggle switch.
 K_1 ; K_2 ; K_3 = 36-way terminal strip block.
 PCB Type 884030.





884030

printer manual to see whether these pins are actually available for this purpose.

The printer sharing box will generally be located close to the printer. PCB connectors K1, K2 and K3 are 36-way straight headers. Three cables are required for connecting the completed PCB between the computers and the printer.

Two 10-15 cm long adaptor cables are made from flatcable with IDC (press-on) connectors at either end. One end is terminated in a 36-way IDC socket for plugging into the PCB header, the other in a female IDC Centronics socket (blue ribbon type) for receiving the printer cable.

The short printer output cable is composed of a female 36-way IDC socket as above, and a 36-way male Centronics plug.

Current consumption of the printer switch is about 200 mA.

03

OMA-2500 TIME STANDARD RECEIVER

OMA-2500 is a 1 kW time standard transmitter on 2500 kHz. The station is located in Lublice, Czechoslovakia, and is operated by the Astronomical Institute of the Czechoslovak Academy of Sciences.

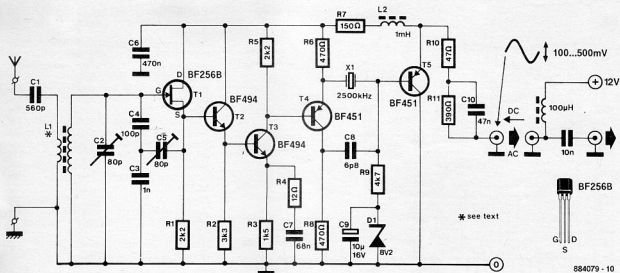
Contrary to time standard transmitters in the VLF band (DCF77, HBF), modulation is pure AM instead of a combination of AM and PSK or FSK. This means that the seconds pips transmitted by OMA-2500 are free from phase noise, which is a

must for some types of PLL, particularly in communications equipment, where the 2500 kHz signal supplied by a time standard receiver is used for generating or deriving other frequencies of equal stability.

Transistor T₁ is configured as a regenerative buffer which acts as an active filter with an effective Q (quality) factor of about 1,000 at a 3 dB bandwidth of 2.5 kHz. The received signal is further raised in amplifier T₂-T₃ before it is ap-

plied to active crystal filter T₄-X₁ which ensures a 3 dB bandwidth of about 500 Hz. Output amplitude of the receiver is sufficient for driving almost any type of simple PLL. The receiver is powered via the download cable at the output to enable it to be mounted in a noise-free environment.

Inductor L₁ is wound as 2 turns (primary) and 80 turns (secondary) of 0.3 mm dia. enamelled copper wire on a Type T50-2 core. Quartz crystal X₁ is a



884079 - 10

2500 kHz type for series resonance. Construction of the receiver should follow the standard rules for RF circuits: keep all connections as short as possible, and use ample screening and decoupling.

Adjustment: set a function generator to 2.5 MHz at $U_s = 10$ mV. Connect the output to C1. Connect an AC-coupled oscilloscope to the source of T1, and peak C2. It may be necessary to reduce or increase the number of windings of the secondary of L1 to obtain resonance at

2.5 MHz. Reduce the signal amplitude and redo the adjustment of the trimmer. Disconnect the function generator, and connect the aerial. Connect the scope to the output of the circuit. Peak C5 for optimum amplitude of the AM signal, but make sure that this is not greater than 500 mV. Remember that T1 is a regenerative stage, so that the settings of C2 and C5 interact. If necessary, readjust the trimmers to ensure that the signal at the collector of T3 is stable, and not clipped during night-time

reception, when OMA-2500 is received with high field strength throughout Europe. Daytime reception in western and northern Europe will mostly range from poor to just usable, depending on propagation conditions and location of the receiver.

The circuit is fed from 12 V, and consumes about 10 mA. Finally, bear in mind that a good aerial (long wire or rhombic quad) is imperative for reliable reception.

0 3 7

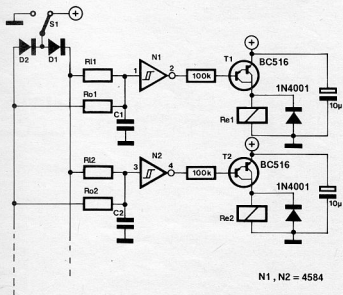
PROGRAMMABLE SWITCHING SEQUENCE

The proposed control circuit is shown in the diagram as containing two relays, but this number may be increased if necessary. The switching sequence is determined by the time delay of an RC network at the input of a gate that is used to energize a relay via a darlington transistor.

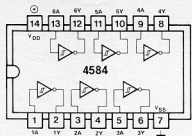
When S1 is connected to the supply voltage (as shown in the diagram), the input capacitor, C1, C2, ... begins to charge via a resistor, R1, R2, ... and diode D1. After a given time, depending on the time constant of the relevant RC combination, the voltage across the capacitor has reached a value sufficient to toggle the gate. The relevant transistor is then switched on, and the relay is energized.

By giving the input of each gate a different time constant, the sequence of switching is determined.

When S1 is switched to ground, the opposite happens. Diode D1 is reverse-biased and the capacitors, C1, C2, ...



N1, N2 = 4584



discharge via resistors R_1, R_2, \dots , and diode D_2 . The discharge time constant determines how fast the capacitors can discharge and re-toggle the gates. So, here again the switching sequence is determined by time constants. The gate with the shortest time constant will always toggle first.

The supply voltage may lie between 5 V and 15 V, but must, of course, be equal to the operating voltage of the relays. Furthermore, the BC516s must not switch more than 400 mA, and this again influences the choice of relay. A good,

practical energizing current for the relays is 200 mA. The values of resistors R_1 and R_2 may lie between 1 k Ω and 10 M Ω ; the value of capacitors C_1, C_2, \dots , between 10 pF and 100 μ F. Time constants exceeding 1,000 seconds create problems in practice, because the leakage current of the electrolytic capacitors then becomes comparable with the charging current. In general, choose the time constants so that two consecutive ones always differ by at least 0.1 s.

0 3 8

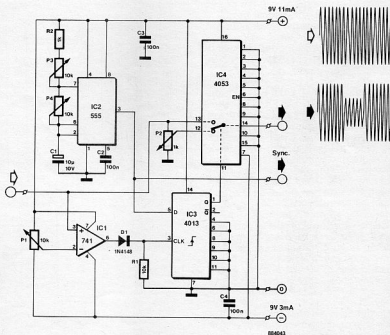
BURST GENERATOR

A burst generator is indispensable for testing the dynamic response of loudspeakers, and, in some cases, AF amplifiers. The fact that a number of cycles of a sinewave are applied to the loudspeaker under test, and not a continuous signal, eliminates the adverse effects of reverberation, reflection and echoes which are otherwise caused by the test room, and are almost inevitably picked up by the test microphone. In addition, the burst provides a good indication of the loudspeaker's performance in respect of voice coil transient response, resonance, and ringing.

The test signal provided by an external sinewave generator is switched on and off at or around the zero crossing, depending on the setting of phase control P_1 . The pause amplitude can be set by P_2 , while controls P_3 and P_4 are used for adjusting the duration of the pause and the burst respectively. It should be noted that the settings of these potentiometers interact, so that an oscilloscope is required for correct alignment. The duration of pause and burst is not related to the input signal. This means that the number of cycles supplied by the generator increases with the frequency of the sinewave applied to the input, unless, of course, P_3 and P_4 are re-adjusted.

Comparator IC_1 converts the sinewave at the input into a rectangular signal. The switching takes place at a specific instantaneous amplitude of the sinewave, set by P_1 . The timing of the switching instant is arranged by astable multivibrator IC_2 , and is copied in bistable IC_3 on the first positive edge of the clock signal. Output Q goes high, so that the pole of electronic toggle switch IC_4 is connected to pin 12, and hence carries the attenuated sinewave burst.

The burst generator is not critical in respect of supply voltage, as long as this remains between ± 5 V and ± 9 V. Do not exceed ± 9 V on penalty of damaging IC_4 .



I/O EXTENSION FOR AMIGA 500

The Commodore Amiga is claimed to be a computer with plenty of facilities for extension circuits. The model 500, for instance, comes with no fewer than twelve connectors and sockets. There are, however, awkward constraints to the practical use of all these extension facilities. The SERIAL CONNECTOR is cumbersome to use with TTL circuits because of the ± 12 V logic levels on it. The use of the 86-PIN CONNECTOR on the machine is complex and risky because of the unbuffered connection to many internal signals. The one remaining option is the PARALLEL CONNECTOR, which can be extended to a maximum of 56 I/O lines as shown here, with the possibility to realize a bidirectional port. The circuit was designed and built for the Amiga 500 computer. It is likely to work equally well on models 1000 and 2000, but this has not been tested in practice.

Output lines BUSY, P-OUT and SEL on the PARALLEL CONNECTOR can be programmed to supply a 3-bit address selection code which is applied to binary decoder IC1. Octal bus buffer ICs is the input port at address 2, latch IC4 the output port at address 3, and transceiver IC3 the bidirectional port at addresses 0 (read) and 1 (write). The remaining 3 addresses (lines E4, E5 and E6) can be used for $3 \times 8 = 24$ additional I/O lines. Line 7 on IC1 may not be used for selecting an input or output port, and is used instead for driving READY LED D: when none of the ports on the I/O extension is being selected. It should be noted that IC3 is not a latch, which means that it can only output data for as long as it is written to by the microprocessor. Output port IC4 does have a latching function, so that datawords are kept stable on the outputs until overwritten by the microprocessor.

The accompanying listing is intended as a guide to writing software for the I/O extension. As an example of the practical use of the subroutines, instruction

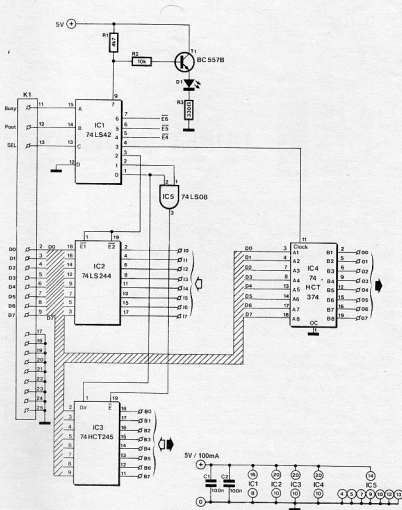
```
a = l:n = 123:GOSUB Wr <CR>
```

sends dataword 123₁₀ to IC3, which then functions as an output port. Conversely, instruction

```
a = 2:GOSUB Rd:PRINT n <CR>
```

reads the dataword applied to IC3, and prints it on screen.

Subroutine Init need only be called once at the beginning of the programming session. Input ports must not be written to. The I/O extension should be fed from a separate 5 V supply.



```
Init:
POKE 12571136&,199
POKE 12570624&,255
POKE 12575489&,0
RETURN
```

```
'call once after power-on
'BUSY, P-OUT and SEL = output bits
'select address 7 (light READY LED)
'set port to input
```

```
Rd:
POKE 12575489&,0
POKE 12570624&,248+n
n=PEEK(12574977&)
POKE 12570624&,255
RETURN
```

```
'load contents of address a in variable n
'set port to input
'select address a
'read value
'light READY LED
```

```
Wr:
POKE 12570624&,248+n
POKE 12575489&,255
POKE 12574977&,n
POKE 12570624&,255
RETURN
```

```
'store variable n in address a
'select address a
'set port to output
'write value
'light READY LED
```

An increasing number of electronic components, and in particular integrated circuits, is now only available as surface-mount devices (SMDs). Circuit design on the basis of these leadless, tiny, components invariably poses problems to many because there is no way to go round making a printed circuit board for building and testing prototypes. Making PCBs for SMD based designs is cumbersome and time-consuming. In many cases it will, therefore, be desirable to develop the circuit as it would have been done using ICs and components of standard size. The PCB adaptors introduced here make this possible. With the exception of the general-purpose type, they are slightly larger than ICs of normal size, but still fit in the generally adopted 0.1 in. raster. The adaptor PCBs effectively enable a range of SMD ICs to be handled just as their normal-size equivalents, and so alleviate the plight of designing and etching a new PCB for every experiment or minor change to the circuit. SMD ICs with 8, 14 or 16 pins are usually housed in a 'narrow' enclosure, and 16,

20, 24 and 28 pin types in a 'wide' enclosure.

The printed circuit board shown here allows making multiple adaptors that can be used for fitting:

- Narrow SMD ICs with a maximum of 16 pins. For 8 and 14 pin types, the PCB can be cut to the required length.
- Wide SMD ICs with a maximum of 28 pins. PCB sections are cut off to the required length as above.
- SMA transistors, capacitors and resistors. These are arranged in a DIL configuration on a general-purpose adaptor to enable fitting networks and circuit sections as complete modules on a standard prototyping board. The size of this adaptor does not exceed that of a standard 16-pin integrated circuit.

Suitable lengths of terminal strip are pushed through the holes at the underside of the boards to create pins for fitting the modules in standard IC sockets.

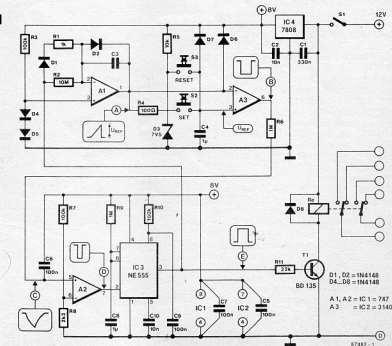
EPS 884025

TW

WIPER DELAY

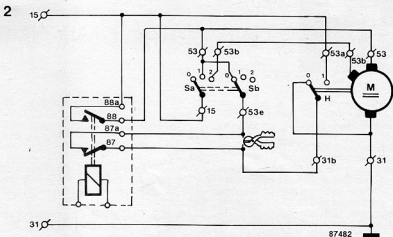
This two-key wiper delay circuit is remarkable for its simplicity and ease of use. The wipe is started by pressing the SET switch, which also serves to adjust the length of the wipe interval. The circuit is turned off by pressing the RESET button.

The wiper delay shown in Fig. 1 consists of three opamps and a monostable multivibrator (MMV). Opamp A₁ is set up as a triangular wave generator, controlled by the output of the MMV. When this is low, a slowly rising sawtooth voltage appears at the output of A₁. The rise time of the sawtooth depends on R₂-C₃. Opamp A₂ compares the voltage across C₃ to the instantaneous sawtooth amplitude. The output of A₂ drops from 8 V to 0 V when the sawtooth voltage exceeds U_{IC2}. This change in the output voltage of A₂ is delayed by R₇-C₆ and passed to A₃, so that the MMV is triggered somewhat later. The wipers are switched on via T₁ and Re when pin 3 on the 555 goes high. Also, C₅ is rapidly discharged via D₁ and R₁, while D₂ prevents the voltage across C₅ becoming positive. When the MMV output goes low, A₁ generates a new sawtooth period.



When the circuit is first switched on, C_4 is discharged, and the output of A_1 is slightly higher than 0 V due to V_{IC-E} of the internal output transistor. This causes the outputs of A_3 and A_2 to remain low, so that the wiper relay remains energized initially. When **SET** is pressed, C_4 is charged via R_5 , causing the output of A_3 to go high, and the circuit to be stopped. The delay circuit around A_2 is necessary to prevent C_4 being discharged completely after pressing the **set** button.

The relay contacts should be wired such that the dashboard switch is bypassed when the relay is energized, and that the hold switch, H, for the wiper motor is opened—see Fig. 2. Due attention should be given to the correct connection of the hold switch on penalty of short-circuiting the car battery.



04

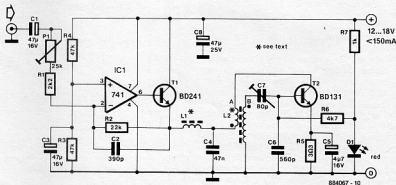
WIRELESS HEADPHONES (TRANSMITTER)

A circuit for the transmission, with good quality, of the sound output of a TV receiver over a couple of metres.

The input signal for the circuit is taken from the headphone or video recorder output of the TV receiver. If these are not available, NEVER ATTEMPT TO FIT ONE YOURSELF. THE CHASSIS OF THE TV SET MAY BE AT A LETHAL HIGH VOLTAGE.

The audio signal is amplified by IC_1 , which has been given some extra 'body' by the addition of an output buffer, T_1 . Capacitor C_4 has a potential that is equal to half the supply voltage (via R_3 - R_4), on to which the amplified audio signal is superimposed. The resulting varying direct voltage is used as the supply voltage for emit transistor T_2 via the primary of L_2 . The carrier oscillator, also formed by T_2 , can oscillate between 1,750 kHz and 3,500 kHz. The consequent amplitude-modulated signal across the secondary of L_2 is strong enough to span a few metres. A ferrite rod is used as transmit antenna. Diode D_1 serves two functions: it indicates that the transmitter is 'on' and it stabilizes the direct voltage (about 1.5 V) for the oscillator. The supply voltage for the oscillator is thus independent of the 12-18 V line.

The inductors are easily made. A T50-2 toroid with 80 turns of 0.2 mm dia. enamelled copper wire is used for L_1 . A fer-



rite rod of 10 to 20 cm is needed for L_2 : L_2 consists of three turns of 0.6 mm dia. enamelled copper wire and should be wound at the ground side of L_2 . This secondary winding consists of 30 turns

0.5 mm dia. enamelled copper wire. It is recommended to power the circuit from a mains adaptor, because a current of up to 150 mA may be drawn.

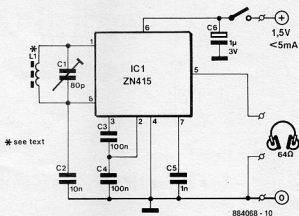
WIRELESS HEADPHONES (RECEIVER)

To arrive at a suitable headphone receiver that meets the requirements of being light, battery-powered, and offering good-quality reproduction, a Ferranti ZN415 was chosen.

This IC contains a complete AM detector, an output amplifier, and operates from a single 1.5 V battery.

The circuit shows the ZN415 in its standard application as a medium wave receiver. Circuit C₁-L₁ is, however, tuned to a frequency above the medium wave band. The output stage drives a high-impedance headphone without any problems. The circuit draws a current not greater than 5 mA, which ensures a good battery life.

The tuned circuit, C₁-L₁, receives the signal from the transmitter described in the preceding article. The inductor consists of 40 turns 0.2 mm dia. enamelled copper wire close-wound on a 20 mm dia. ferrite rod. For optimum reception, C₁ must be adjusted with a non-metal screwdriver. Note that the transmit frequency lies somewhere between 1,700 and 3,400 kHz.



LEAD-ACID-BATTERY CHARGER

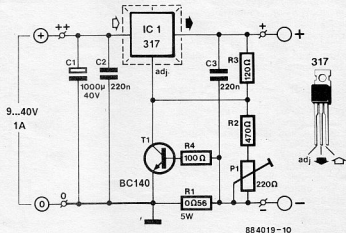
Modern sealed lead-acid batteries are simplicity itself in use. In contrast to NiCd batteries, they may be charged by connecting them to a constant voltage (at the correct level). The charging current then gives a pretty good indication of the state of charge.

These batteries may also be charged at a rapid rate, as long as the charging current is limited at the onset of the charging process. Dependent on the make, a charging current of several times one tenth of the capacity in Ah is permissible. For instance, a 5 Ah battery may be charged with an onset charging current of 1 A. The charging voltage may then be 2.45 V per cell. At such a (relatively) high voltage, the current has to be limited, otherwise the onset charging current through a flat battery may be as high as 10 A.

The proposed charger, whose circuit is shown in Fig. 1, incorporates a 'standard' voltage regulator, IC₁, and a variable current limiter consisting of T₁, R₁, and R₂. As soon as the current through R₁ becomes too large, T₁ switches on and the output voltage drops. The output voltage is given by: $1.2(P_1 + R_2 + R_3) / R_3$ [volts].

The current limiter becomes operative

1



at a current of $0.6/R_1$ [amperes].

The charging voltage for a 6-V battery that is required to be charged rapidly is $3 \times 2.45 = 7.35$ V. The total effective value of $R_2 + P_1$ should then be 585 ohms. In practice, this value may be slightly different.

For charging 12-V batteries, the value of $R_2 + P_1$ needs to be about 1290 ohms.

The input voltage should be not less than 3 V higher than the output voltage. The LM317 needs a heat sink, not because it is easily damaged, but because it cannot deliver its full output current at high temperatures.

It is, of course, possible to use the proposed circuit as a common supply unit.

Parts list

Resistors ($\pm 5\%$):

R1 = 0R56; 5 W

R2 = 470R

R3 = 120R

R4 = 100R

P1 = 220R preset

Capacitors:

C1 = 1000 μ ; 40 V

C2, C3 = 220n; MKT

Semiconductors:

T1 = BC141

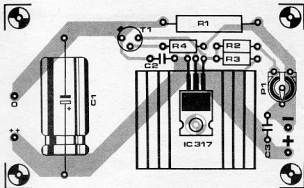
IC1 = LM317

Miscellaneous:

Heat-sink for IC1.

PCB Type 884019

2



0 4 5

STEP-UP SWITCHING REGULATOR

Maxim Integrated Products have recently introduced a series of integrated step-up switching regulators designed for simple, minimum component count DC-DC converters. All control and stabilization functions are contained in an 8-pin DIP package: a bandgap voltage reference, oscillator, voltage comparator, catch diode, and an N-channel medium power MOSFET. In addition, the ICs have a built-in low-battery (LB) detection circuit.

One of these new chips is the Type MAX641, which is of particular interest for no-break 5 V supplies in computers. In the application shown here, the output current of the step-up regulator is boosted by an external bipolar power transistor, T1. The low-battery detector compares the voltage at input LB1 with the internal +1.31 V bandgap reference. Output LB0 goes low when the voltage at pin 1 drops below 1.31 V. The low-battery threshold voltage, U_{LB} , is determined by potential divider R1-R2 as

$$U_{LB} = 1.31(R1/R2 + 1) \quad [V]$$

R2 is typically 100 k Ω . In the application circuit shown here, LED D1 at the LB0 output lights when the input voltage drops below 2.62 V.

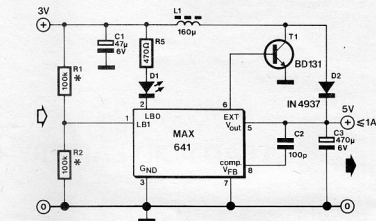
It is possible to make the output voltage adjustable by connecting input VFB to a potential divider R3-R4 instead of ground. This option is shown inset in the circuit diagram. The output voltage, U_o , then becomes

$$U_o = 1.31(R3/R4 + 1) \quad [V]$$

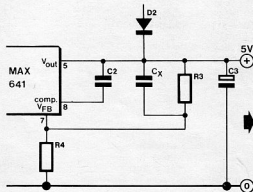
R4 is, again, typically 100 k Ω . Cx is 100 pF. Remember to observe the voltage rating of Cx.

Maximum output current of the circuit is 1 A. The input voltage should remain below 5 V. Maximum conversion efficiency is about 80%.

As to components: the minimum value for L1, L_{min} , is expressed by



* see text



884086-10

$$L_{min} = U_{in} / (2f_{osc} I_{max})$$

I_{max} depends on the current rating of the inductor and external power transistor. Factor f_{osc} is the converter oscillation frequency, 45 kHz. The available output power can be increased by either rais-

ing the input voltage or lowering the inductance. This causes the current to rise at a faster rate, and results in a higher peak current at the end of each cycle. The available output power increases since it is proportional to the square of the inductor current. The calculation of

the maximum inductance of L_1 is, unfortunately, relatively complex, and falls outside the scope of this introduction to the MAX641. The inductor should be able to handle the required peak currents whilst having acceptable series resistance and core losses. The inductor in this application circuit should be rated at 2.5 A minimum. Due account should be taken of the rela-

tively high ripple amplitude at the output of the converter. The ripple voltage is composed of high (45 kHz) and low-frequency components, and is practically impossible to suppress further. Finally, D_2 should be a fast Schottky diode. Alternatives to the type shown in the circuit diagram are the Types IN5817 (1 A), IN5821 (3 A), or the BYV27 (2 A). General purpose rectifiers from

the IN400x series are not recommended because their slow turn-on time results in excessive losses and poor efficiency.

Source: Fixed Output 10 Watt CMOS Step-Up Switching Regulators. Maxim Integrated Products.

0 4 6

FISHING AID

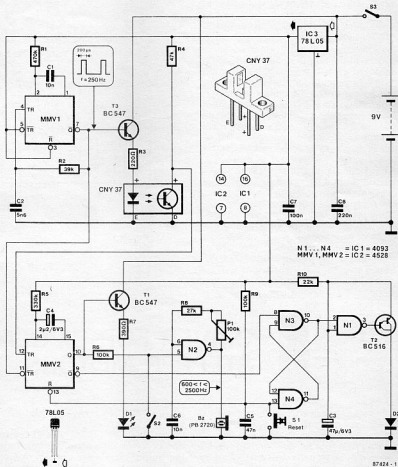
This circuit provides audible and visible warning when a fish is nibbling the bait. Although this event is fairly easy to signal with electronic means, the circuit is relatively extensive to ensure that it can be powered from a 9 V battery.

The circuit is based on a slotted optocoupler Type CNY37, and a home made notched wheel. Unfortunately, the current amplification of slotted optocouplers is very low (0.02 min.), requiring considerable current to be fed through the LED before a usable collector current flows in the phototransistor. To avoid rapidly exhausting the battery, MMV₁ pulses the LED at about 250 Hz and a duty factor of 0.05. MMV₂ detects the presence of these pulses. When a fish pulls at the bait, the notched wheel revolves in the slot, and intermittent pulse bursts are received at the trigger input of MMV₂. Green LED D₁ lights, buzzer Bz sounds, and bistable N₁-N₂ is set, so that red LED D₂ flashes at a 1.5 Hz rate. D₁ and the buzzer are turned off when the fish gets off after nibbling the bait, but D₂ continues to flash. The circuit around N₁, T₂ and C₃ then serves to keep the current consumption as low as possible. The circuit can be reset by pressing S.

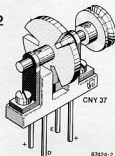
Preset P₁ enables adjusting the frequency of the buzzer oscillator between 600 and 2500 Hz. When several fishing rods are being used, each can be assigned a particular signal tone. The buzzer can be switched off by means of S₂.

A suggested construction of the light barrier and the notched wheel is shown in Fig. 2. A small shaft is used in combination with a reel around which the fishing line revolves. The slots cut into the detection wheel should not be too wide: 1 mm is a good starting value. The detection sensitivity is determined by the number of slots in combination with the reel diameter. The light barrier should be screened from daylight.

In the stand-by condition, the circuit consumes no more than 4 mA, which goes mainly on account of the LED in the optocoupler. In the actuated state, the current consumption rises to about 12 mA.



2



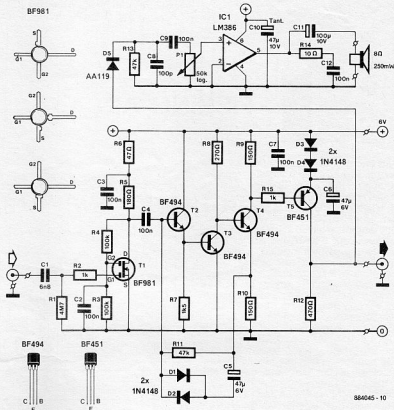
87424-2

Wideband RF signal tracer

This simple and versatile circuit can aid in troubleshooting defective RF amplifier circuits. The usable frequency range of the tracer is about 100 kHz to 30 MHz. Measured signals (0.5 mV to 500 mV) are amplified, detected and made audible with the aid of a small loudspeaker.

MOSFET T₁ functions as an amplifier with a high input impedance to avoid loading the signal source. Transistors T₂, T₃ and T₄ form a high-gain logarithmic amplifier that drives AM demodulator T₅-D₁. A single chip AF power amplifier, IC₁, is included to make detected signals audible. Testing of RF equipment is carried out simply by "probing around" at suitable locations in the circuit and listening to the detected signal, whose relative amplitude can provide an indication of possible sources of malfunction. The tracer's logarithmic amplifier obviates the need for frequent re-adjustment of the volume control, P₁. The unit is so sensitive that it produces audible output when the input is only held near the circuit section under test.

As to construction of the tracer, this is best fitted in a short length of ABS tubing to make a probe with three connecting wires for the supply voltage and the loudspeaker. Constructors are advised to strive for ample RF decoupling and short connections in view of the relatively large bandwidth. Current consumption of the tracer is about 100 mA from a regulated 6 V supply.



86A045-10

DRIVER FOR BIPOLAR STEPPER MOTORS

For some applications, the *Universal control for stepper motors* (see ⁽¹⁾) may be considered too extensive a circuit. Many small motors with limited speed range can be equally well controlled by a relatively simple circuit, based on, for instance, the Type SAA1027 or TEA1012 ⁽²⁾. Most commercially available controllers are, however, intended for driving unipolar stepper motors, which are now gradually superseded by bipolar types of similar size. In practice, the latter can provide a larger torque, but require a different type of controller. The recently introduced Type MC3479P from Motorola requires a minimum of external components for controlling a bipolar stepper motor. The maximum quiescent stator current, I_s , depends on the value of resistor R between pin 6 and ground:

$$I_s = (U_s - 0.7) / 0.86R \text{ [mA]}$$

where R is given in k Ω . The above relation between I_s and R is valid as long as the output transistors are not operated in the saturated area. The saturation point is reached sooner at low levels of the supply voltage, or when the ohmic resistance of the stator winding is fairly high. The manufacturers state a maximum current of 350 mA per stator.

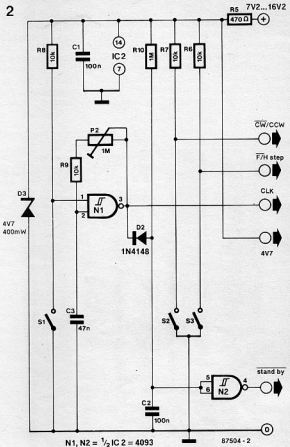
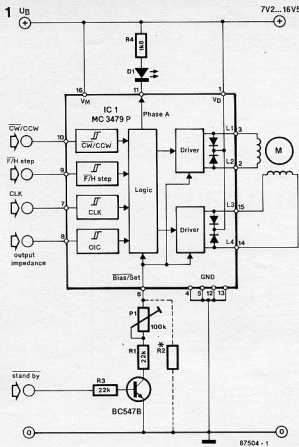
The supply voltage for the motor (pin 16) depends on the ohmic resistance of the stator windings, and is allowed to vary between 7.2 and 16.5 V. When a high supply voltage is used, it must be remembered that the output transistors will not operate in the saturated area to prevent exceeding the set stator current, I_s . The current control used here allows a fairly high step rate at the cost

of an increase in the dissipation of the driver IC, particularly when the motor is held stationary. If necessary, the MC3479P can be cooled by connecting the 4 central ground terminals to a relatively large copper surface on the PCB. The integrated controller has 4 TTL and CMOS compatible inputs (see Fig. 1):

CLK (pin 7): every rising edge of the clock signal causes the motor to revolve one full or one half step, depending on the level at pin 9. The maximum step rate and the minimum pulse width are 80 kHz and 10 μ s respectively.

CW/CCW (pin 10): the logic level applied here determines the motor's direction of travel.

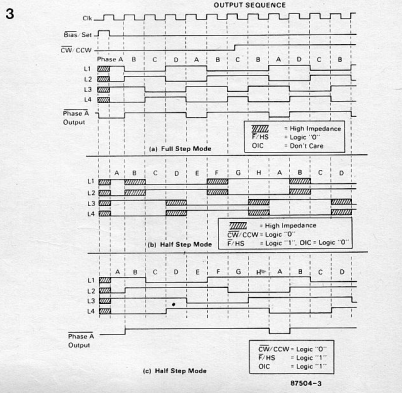
F/H step (pin 9): this input allows selection between full (0) or half step (1) operation—see Fig. 3.



OI (pin 8): this output impedance selection input is only effective in the half step mode. It determines whether the stator winding is effectively disconnected from the driver (0), or connected to the positive supply at both ends (1). The latter option improves the damping of the motor in the half step mode, and will prove useful at relatively low step rates.

Pin 11 of the driver IC is an open-collector output with a current capacity of 8 mA, activated during period A in Fig. 3. A LED connected to this output will flash rhythmically when the motor is running.

Transistor T₁ was added to obtain a reset function. No stator current flows, and the logic circuitry in the driver is reset, when the stand by input is driven low. When a logic 1 is applied, the motor is energized starting from state A. The addition of R₂ makes it possible to switch the driver to the power-down state, rather than the reset state. The stator current is reduced to the value set with R₂, as shown in the above formula. The motor driver is probably best controlled by a computer output port. The circuit in Fig. 2 is intended for stand-alone applications. It is composed of a supply, R₅-D₃, an oscillator, N₁-C₂-R₈-P₂, and a re-triggerable monostable multivibrator, N₂-C₃-R₁₀-D₂. When S₁ is opened, the oscillator is enabled, and the motor



will start running. The clock frequency, i.e., the step rate, is adjustable with P_2 . The monostable will remain set via D_3 , and T_1 will conduct, as long as clock pulses are applied to the motor driver. The amount of ever reversing stator current is limited by the stator inductance, but can still be increased with the aid of P_1 . When the motor stops, T_1 is turned

off, and the stationary stator current is reduced to the value set with R_3 . The above arrangement keeps the dissipation of the motor and the driver within reasonable limits.

The current consumption of the complete circuit is practically that of the motor alone (700 mA max.). The motor driver IC consumes about 70 mA.

0 4

NON-INTERLACED PICTURE FOR ELECTRON

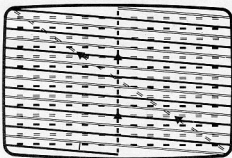
Owners of the Acorn Electron home computer may well object to its interlaced, and therefore slightly instable, picture. There is a trace of display flicker in non-moving areas on the screen, and this is mainly due to the internal video processing circuitry operating on the basis of interlacing, a technique used in conventional TV transmission for smoothing the appearance of moving picture areas. Arguably, interlacing is not very useful in computers, since these work with text in most applications. Special displays with a relatively long afterglow time are no remedy for this awkward problem, and that is why the present circuit was designed. It effectively switches off the interlace function, and so ensures a restful display, albeit that the individual lines that make up the characters become slightly more prominent.

Figure 1 shows that a TV picture is composed of 625 lines divided between 2 rasters of 312.5 lines each. In an interlaced picture, these rasters are vertically shifted by one line. This is done by starting the second raster x and a half time later than the first raster. Interlacing can thus be rendered ineffective by starting the second raster half a line period earlier (i.e., after 312 lines rather than 312.5). To retain the normal number of lines (625), the second raster is arranged to comprise 313 lines.

The ULA chip (Uncommitted Logic Array) in the Electron computer provides a horizontal and a composite synchronization signal, which are shown in Figs. 3a (HS) and 3b (CSYNC) respectively. With reference to Fig. 3c, and the circuit diagram in Fig. 2, MMV_1 forms a new vertical synchronization pulse, VS, with the aid of the CSYNC signal. The period of pulse VS is different for the first and second raster, so that MMV_2 is needed to make VSYNC equally long in both. MMV_2 is triggered on the first line pulse (HS) that occurs when VS is active, and is retriggered when VS goes low—see Fig. 3d. The length of the VSYNC pulse so made is about 160 μ s, or about 2.5 times the line time (64 μ s). The HS and the new VS signal are combined in XOR gate N_1 for driving the video modulator. Gate N_1 serves to buffer the HS output of the ULA.

The final results obtained with the circuit depend mainly on the type of TV

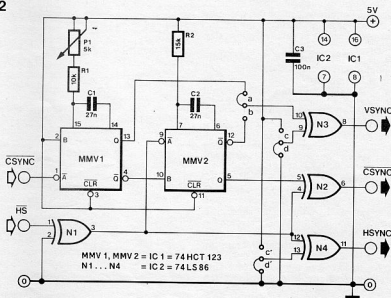
1



first raster second raster
 flyback (blanked)

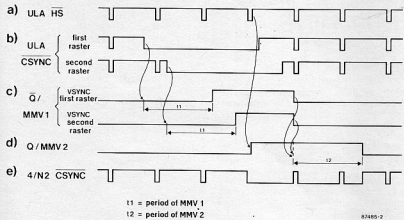
87485-1

2



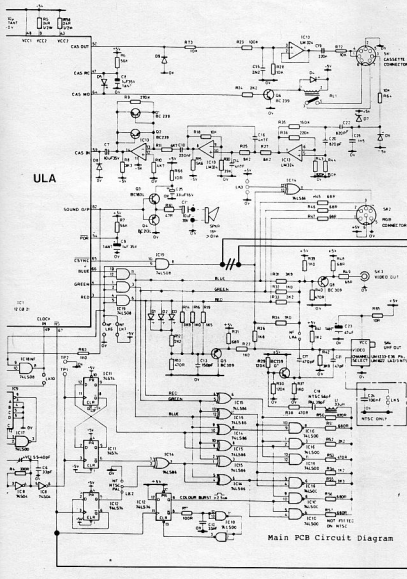
87485-3

3.



87485-2

4



set or display used, and may not be optimum when the TV is driven via its RF input. On an older type monochrome set, the central area of the picture was stable, but the upper and lower areas gave a less favourable look. Good results were obtained, however, from the use of Type TX chassis, which are currently the basis of TV sets sold under many different names and licenses. Even better performance can be expected from a video monitor, whose (TTL compatible) H and V synchronization inputs can be driven by N1 and N3 respectively. The polarity of the sync signals can be selected with the aid of wire jumpers. Connections c and c' result in VSYNC and HSYNC. The choice between jumper a or b depends on the type of display used. Preset P1 is adjusted until the picture appears vertically synchronized: the adjustment is fairly critical when jumper a is used. The final results obtained with the circuit can be judged from looking at a few characters in the upper and lower area of the screen. The modest current consumption of the circuit, 10 mA, makes it possible to power it direct from the Electron computer.

87485-4

This is one of the very few 'one-armed bandits' to which the maxim *the sole way to win is not to gamble* is not applicable. In other words, this circuit does not have a slot for inserting coins: every play is free.

Actuation and release of the 'PLAY' button, S₁, causes the circuit to become operative. Series regulator T₁ is driven into saturation by T₂, which is controlled by N₂-N₇. The outputs of N₂, N₁₁, and N₁₀ go high in succession, and disable counters IC₃, IC₄ and IC₅, which are all clocked by oscillator N₁₂-N₈, and reset by the pulse at their Q₃ output. The 3 LEDs driven by each of the counters, therefore, lights cyclically. When a counter is disabled by the high level at its CE input, one of the LEDs in the 3 groups remains illuminated. The

output state of the counters is not predictable because of the inconstant delay between the disable instants. NAND gates N₁₃-N₁₅ detect the winning combinations, i.e. LED D₂ lights, and Bz₁ is sounded, when 3 identical counter outputs are activated. Note that diodes D₃-D₅ form a 3-input OR gate, and that the buzzer also produces sound when the LEDs are flashing, since the pulses at output Q₂ of IC₃ enable the oscillator intermittently.

The play is ended when the voltage across C₃ is high enough for gate N₇ to change state. T₂ is turned off, and T₁ no longer powers the circuit. An on/off switch is not required for the fruit machine, thanks to its very low current consumption in the de-activated state.

Parts list

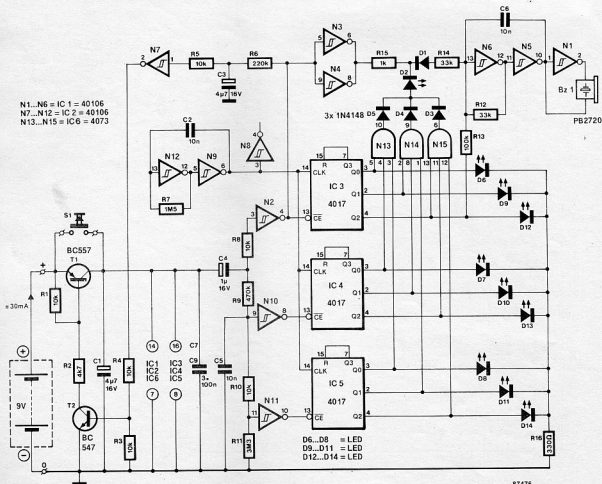
Resistors (± 5%):

R₁;R₃;R₄;R₅;R₆;R₁₀ = 10K
R₂ = 4K7
R₆ = 220K
R₇ = 1M5
R₉ = 470K
R₁₁ = 3M3
R₁₂;R₁₄ = 33K
R₁₃ = 100K
R₁₅ = 1K0
R₁₆ = 330R

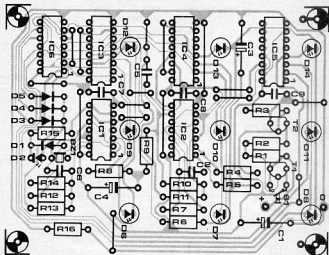
Capacitors:

C₁;C₃ = 4µ7; 16 V; axial
C₂;C₅;C₆ = 10n
C₄ = 1µ; 16 V; axial
C₇;C₈;C₉ = 100n

1



87476



Semiconductors:

D₁; D₃; D₄; D₅ = 1N4148
 D₂; D₆; D₇; D₈ = LED (red)
 D₉; D₁₀; D₁₁ = LED (yellow)
 D₁₂; D₁₃; D₁₄ = LED (green)
 IC₁; IC₂ = 40106
 IC₃; IC₄; IC₅ = 4017
 IC₆ = 4073
 T₁ = BC557
 T₂ = BC547

Miscellaneous:

S₁ = momentary action push button.
 Bz = PB2720 buzzer (Cirkit stock no.
 43-27201).
 PCB Type 87476

05

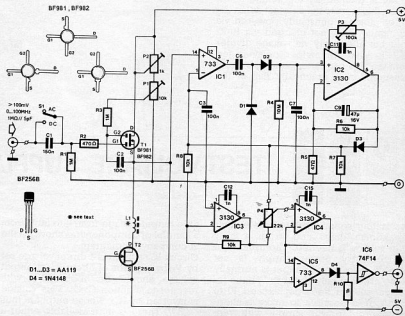
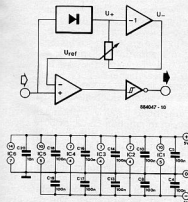
WIDEBAND LEVEL-INDEPENDENT TRIGGER PREAMPLIFIER

This circuit eliminates the difficulty in re-adjusting the trigger level of an oscilloscope or frequency meter any time the amplitude of the input signal changes. The block diagram shows that the trigger pulses are supplied by a fast comparator that compares the instantaneous input signal amplitude with a reference voltage deduced from the difference between the peak amplitude of the positive and negative half cycles of the rectified input signal. The circuit is fast enough to handle input signals with a frequency of up to 100 MHz, and has a sensitivity of 100 mV_{pp}.

With reference to the circuit diagram, the input signal is raised in a wideband preamplifier based around a UHF dual-gate MOSFET, T₁, fed by constant current source T₂. Presets P₁ and P₂ define the potential at the source of T₁, and hence form the fine and coarse offset compensation adjustments for the

direct-coupled chain of opamps IC₁-IC₃. The signal rectifier and direct voltage amplifier are formed by D₁-D₈, R₁-C₇ and IC₂. The relatively weak signal is raised further in direct-coupled opamps IC₃ and IC₄ for comparison with the amplified measuring signal in opamp IC₅. Schmitt-trigger/inverter IC₆ cleans the trigger signal before it is applied to the test instrument. The trigger sensitivity is set by potentiometer P₄. Choke L₁ is wound as 4 turns of 0.2 mm

dia. enamelled copper wire through a small ferrite bead. MOSFET T₁ may be replaced by a Type BF991 or BF966 if either of these is easier to obtain locally. The circuit should be constructed with due attention paid to the relatively high frequencies it can handle. In this context, it is recommended to use a large copper area as an effective ground plane onto which the parts are fitted. The shortest possible connections, ample screening, and effective decoupling



of the supply voltage at various point in the circuit are also a must to ensure correct operation.

Optimum sensitivity is achieved by ad-

justing P_1 , P_2 and P_3 for lowest offset measured at the output of ICs. These adjustments are carried out after a warming-up period of a few minutes,

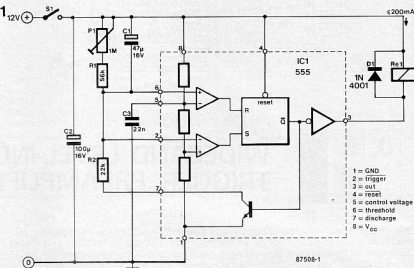
and with the input of the preamplifier temporarily short-circuited.

05

FAST STARTING WIPER DELAY

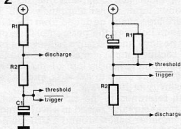
A wiper delay is essentially a bistable multivibrator whose off-time is adjustable with a potentiometer. Many wiper delay circuits are based on the Type 555 timer in its standard application circuit, which has the disadvantage of introducing a delay of about 1.6 times the set interval before the first wiper action takes place. This is especially annoying when an interval of, say, ten or more seconds has been set. This circuit is also 555 based, but is unique in that it arranges for the wipers to be activated immediately at power-on.

The circuit diagram of Fig. 1 shows the internal organization of the 555 timer to aid in clarifying the operation of the present circuit. When S_1 is closed, pin 6 is immediately pulled to +12 V because C_1 is discharged as yet (see also Fig. 2b). The bistable in the 555 is reset, the output goes low, and Re_1 is energized. This forms the basic difference with the standard application of the 555, where C_1 , connected as shown in Fig. 2a, delays the relay action until charged to $\frac{1}{2}$ of the supply voltage. Returning to Fig. 1, C_1 is charged via R_2 and the 555's internal transistor when the output is activated. The bistable is reset when the voltage at pin 2 drops below $\frac{1}{2}V_{cc}$, causing the relay to be de-energized, and C_1 to be discharged via R_1 - P_1 . The discharge time, and hence the wipe interval, is defined by the setting of P_1 . When this is set to the shortest delay, the wiper motor is constantly powered via Re_1 , since C_1 is not charged via P_1 - R_2 only, but effectively via voltage divider P_1 - R_1 - R_2 also. The wiper delay is fed from the 12 V car battery, and its current consumption is practically that of the



relay alone. Note that the coil current may not exceed 200 mA.

2



05

TEST-VOLTAGE SUPPLY

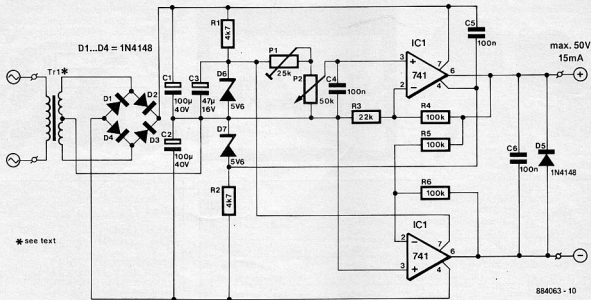
For testing zener diodes, base-emitter breakdown, diacs, and so on, a fairly high voltage is needed. The usual type of laboratory power supply is not suitable, because its output is normally of the order of only about 30 V. If the required current does not exceed 10 to 15 mA, it is possible to make a short-circuit-proof power supply with vari-

able output voltage from 0 to 50 V from a handful of components as shown in the accompanying diagram.

Circuit IC₁ amplifies a direct voltage set by P_2 by a factor of about 6. Its output voltage should be about 25 V with respect to junction C_1 - C_2 . This voltage is inverted by IC₂, whose output is thus -25 V. There is then available either a

symmetrical ± 25 V potential with respect to junction C_1 - C_2 , or 50 V asymmetrical across the outputs of the ICs. The actual value of the voltage is set with P_1 .

The maximum current is limited by the ICs to about 20 mA, so that the likelihood of damage to a component under test is very small. The output is



short-circuit-proof for an indefinite period.

To avoid common-mode problems, and also to make it possible to vary the output voltage to 0, the supply voltages to IC₁ and IC₂ overlap to some extent, which is arranged by D₆ and D₇. Zener D₅ also functions as the voltage reference. The supply to IC₁ must be decoupled separately by a 100 nF capaci-

tor; that to IC₂ is decoupled adequately by C₆ and C₅.

The mains transformer may conveniently (and inexpensively) consist of two 18 V types, otherwise a single 36 V unit is required. The secondary must be able to provide a current of 20 to 30 mA. If two transformers in series are used, make sure that they are in phase.

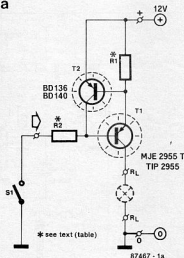
Before inserting the ICs into their

sockets, check the voltage at pins 4 and 7: this should be not higher than 36 V if a 741C is used, or 44 V for other types (741A, 741E, and 741). If the voltage is too high, a transformer with a lower rated secondary (2 x 15 V or 30 V) should be used. If, however, the voltage at pins 4 and 7 becomes lower than 27 V, it may be impossible to obtain an output voltage of 50 V.

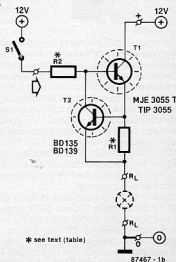
POWER SWITCH FOR CARS

Motorist are generally well aware that car fuses do not blow just like that. None the less, when something appears to be amiss in the electrical circuit, a new fuse is nearly always fitted prior to investigating the possible cause for the malfunction, which then, of course, costs two fuses. The circuits shown here are short circuit proof power switches, or electronic fuses with switch control dimensioned for relatively heavy (lamp) loads in a car. Both circuits are composed of a power switch, T₁, and a current limiter, T₂. The circuit is fully short-circuit and overload resistant, provided T₁ is adequately cooled, and the whole unit is constructed in a sturdy enclosure. The circuit in Fig. 1a has the lower voltage drop of the two, while that in Fig. 1b is used when a TO-218 style Type MJE2955T or TIP2955 is not obtainable. It is interesting to note that the plastic TO-218 package is mechanically interchangeable with the wellknown TO-3 outline, and enables ready mounting of

1a



b



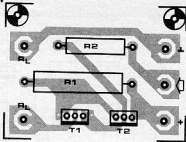
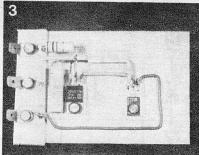
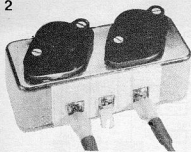


Table 1

Application	R _L [W]	I [A]	R ₁ [Ω]	R ₂ [Ω]	Cooling T ₁ -T ₂
Dashboard lighting	1	0.08	5.6	3300	not required
Courtesy light	2	0.17	2.7	1500	not required
Rear light or parking light	5	0.42	1.2	680	25 cm ²
Brake light	18	1.5	0.33 (5 W)	180 (1 W)	225 cm ²
Fog light or traficator	21	1.75	0.27 (5 W)	150 (1 W)	225 cm ²

Part list

Resistors (±5%):
R₁, R₂ = see text

Semiconductors:

T₁ = MJE2955T or TIP2955 (Fig. 1a)
T₂ = MJE3055T or TIP3055 (Fig. 1b)
T₁ = BD136 or BD140 (Fig. 1a)
T₂ = BD135 or BD139 (Fig. 1b).

Miscellaneous:

S₁ = see text
PCB Type 87467

the transistor onto a flat surface using an insulating washer—see Fig. 2. The use of a die-cast enclosure and TO-3 style transistors is illustrated in Fig. 3. This unit houses two power switches, one of which has its contacts at the rear side. Pay great attention to the correct electrical insulation between the transistors

and the enclosure, and, if required, that between the enclosure and the car body. Switch S₁ is the existing control for the relevant lamp in or on the vehicle. Note the difference in respect of the connection of S₁ in Fig. 1a and 1b. Table 1 shows how R₁ and R₂ are dimensioned in accordance with the current

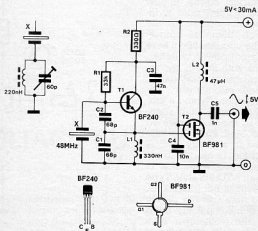
requirement of the load, and also gives a suggested area of the cooling surface. Finally, when the printed circuit board is used, T₁ should be a TIP2955 or a MJE2955T, not a MJE2955, since this has its outer terminals (B-E) reversed.

0 5 5

48 MHz CLOCK GENERATOR

Currently, 48 MHz quartz crystals are widely available at relatively low cost thanks to their use in computer systems. In these, there is often a need for several clock frequencies that can be derived from a central oscillator. When this supplies a buffered 48 MHz signal, it is relatively simple to add a divider circuit that provides lower, phase-synchronous, clock signals of, say, 6, 8, 12, 16 or 24 MHz. Obviously, this obviates the need for separate quartz crystals and associated oscillators, and so economizes on hardware expenses.

A reliable 48 MHz oscillator is fairly difficult to make with HC or HCT gates. The oscillator shown here is, therefore, built around discrete RF transistors. It operates with inexpensive, third overtone series resonance quartz crystals in the range between 44 MHz and about 52 MHz. A parallel L-C network may be



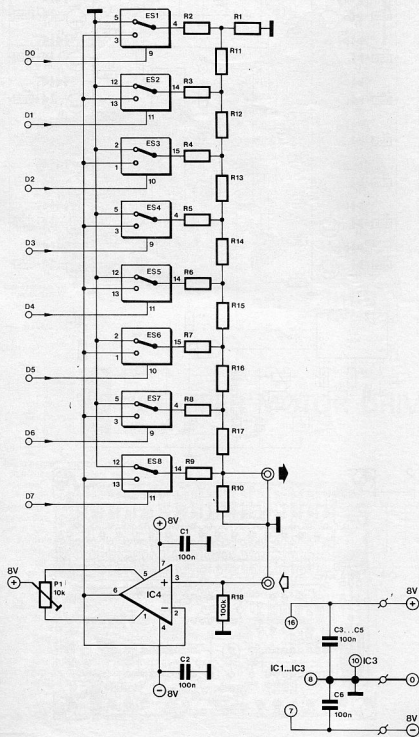
connected in series with the crystal as shown in the circuit diagram for accurate setting of the oscillation fre-

quency to 48.000 MHz, but also for 'pulling' the oscillator a few kilohertz around this frequency if it is used for driving a

frequency multiplier (local oscillator chains in 2 m, 70 cm, or 23 cm amateur radio equipment).

0 5 6

DIGITAL ATTENUATOR



Digitally controlled attenuators almost invariably use some kind of tapped resistor network to simulate a potentiometer. This solution is fine as long as the number of steps required is small. When finer control is required, however, the normally tapped resistor network is hardly ever used because of the large number of components that would be required. The circuit shown here offers relatively high resolution (attenuation range: 48 dB) whilst requiring few components only.

The technique used is similar to that of multiplying DACs (digital-to-analogue converters). In a conventional R-2R ladder DAC, the output voltage is given by $(U_{ref}/384)N$, where N is the binary number applied to the inputs. The direct dependence of the output voltage on U_{ref} makes it easy to obtain a variable attenuator by substituting the input for U_{ref} . The output will then be $(U_{in}/384)N$.

The R-2R ladder network used here is composed of resistors R_1 to R_{17} incl., while electronic switches ES_1 to ES_8 incl. form the switching elements. These are of the two-way type (SPDT), connecting either the input voltage or ground to the inputs of the ladder network. Buffer IC₁ presents a constant impedance to the source. Pin 7 of IC₁, IC₂ and IC₃ should be grounded unless the circuit is operated with bipolar signals. In that case, pin 7 of all three ICs is connected to -8 V.

The circuit can handle signals of up to 400 kHz with a maximum amplitude of about 4 V_{pp}. With signals of lower level, higher frequency response should be obtainable. The high frequency limit is due to the buffer at the input—the electronic switches by themselves can handle signals up to 10 MHz.

The fixed attenuation of the circuit is about -3.5 dB. Signal-to-noise ratio is more than 100 dB at an input signal of 1 V_{rms}. The output offset voltage is compensated by adjusting P₁. Current consumption of the circuit is about 6 mA at $U_b = \pm 8$ V. Finally, it should be noted that TTL circuits can not drive the circuit direct, unless 47 k Ω pull-up resistors are fitted at control inputs D0 to D7 incl.

ELECTRONIC SAND-GLASS

This electronic version of the reversible sand-glass uses a set of LEDs to simulate the passing of sand grains from the upper to the lower bulb. The simple to build circuit is accurate enough for most domestic timing applications.

The circuit diagram appears in Fig. 1. On power-up, shift registers IC₃ and IC₄ are reset by the low pulse from network R₃₅-C₇. A few seconds later, the sand-glass is started. The oscillator in IC₂ generates a clock signal for the shift registers. The clock frequency is adjustable with P₁. Switch S₂ enables selecting one of the three timing periods stated in the circuit diagram. S₁ is a small mercury or ball changeover switch mounted inside the sand-glass. When this is reversed, the switch toggles and so selects the odd or even numbered LEDs. Assuming that S₁ is set as shown in the circuit diagram, every clock pulse causes a logic high level to be shifted into IC₃, for as long as pin 13 of IC₄ remains logic low. The MS bit of IC₃ (output Q7) is shifted into the second shift register, IC₄. Controlled by the register outputs, transistors T₁ to T₁₆ incl. switch off the odd numbered LEDs, and light the even numbered ones

Parts list

Resistors (± 5%):

R₁ . . . R₁₆ incl.; R₆₀ = 330R
R₁₇ . . . R₂₂ incl.; R₂₃; R₃₅ = 10K
R₃₃ = 100K
R₃₄; R₃₅; R₃₆; R₄₁ = 1MΩ
R₃₈ = 1KΩ
P₁ = 100K preset
P₂ = 2K5 or 2K2 preset

Capacitors:

C₁ = 100μF; 16 V; axial
C₂; C₃; C₄; C₅ = 100n
C₆ = 2μ2; 16 V; radial
C₇; C₈ = 1μF
C₉ = 220n

Semiconductors:

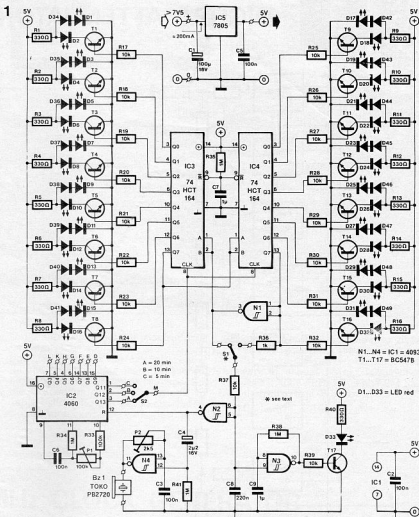
D₁ . . . D₃₃ incl. = red LED
D₃₄ . . . D₄₈ incl. = 1N4148
T₁ . . . T₁₇ incl. = BC547
IC₁ = 4093
IC₂ = 4060
IC₃; IC₄ = 74HCT164
IC₅ = 7805

Miscellaneous:

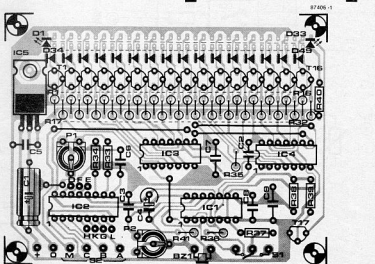
Bz₁ = PB2720 (Tokio; Cirkit stock no. 43-27201).
S₁ = SPDT mercury, ball or tilt switch, e.g.

S₂ = single-pole, 3-position rotary switch plus knob.
PCB Type 87406

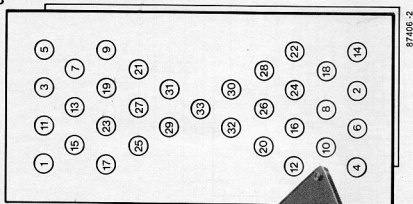
Suitable ABS enclosure.
DC power socket.



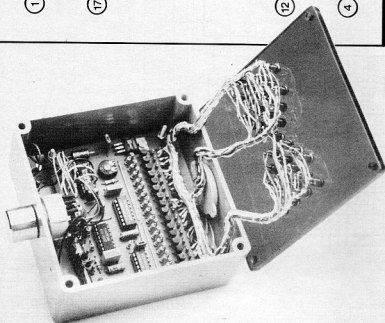
2



3



4



sequentially. When pin 13 of IC₄ goes high, counter IC₂ is reset via N₁-N₂, while oscillator N₄ is started. Buzzer B₂ is actuated and sounds for about 2 seconds (C₄-R₄). The pitch of the tone can be set with P₂.

When the sand-glass is reversed, S₁ toggles, ending the reset state of IC₂. Logic low levels are shifted into IC₃ because pin 13 of IC₄ is logic high. The even numbered LEDs go out one by one, and the odd numbered ones light, until pin 13 of IC₄ goes low again. IC₂ is reset, B₂ produces a short beep, and the sand-glass can be reversed for a new timing period. LED D₃₃ indicates that the sand-glass is operative. The circuit is fed from a small mains adaptor capable of supplying about 200 mA at an output voltage between 7.5 and 12 VDC.

Construction of the sand-glass is straight-forward using PCB Type 87406—see Fig. 2. The position of the LEDs on the front panel of the enclosure is shown in Fig. 3. Make sure that each LED is connected to the corresponding soldering island on the PCB. SPDT Switch S₁ is made from two SPST mercury or ball switches, fitted together but mutually reversed at a suitable position in the enclosure. The action of the switches is tested by reversing the sand-glass and measuring the switch configuration with the aid of a continuity tester or an ohm meter. All parts in the sand-glass enclosure should be fitted securely in view of the reversibility of the enclosure. The socket for connecting the adaptor, and rotary switch S₂, are fitted in one of the side panels. A prototype of the electronic sand-glass is shown in Fig. 4. The detachable front panel that holds the LEDs was cut from perspex sheet.

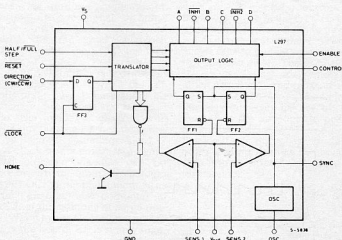
0 5 3

STEPPER MOTOR DRIVER

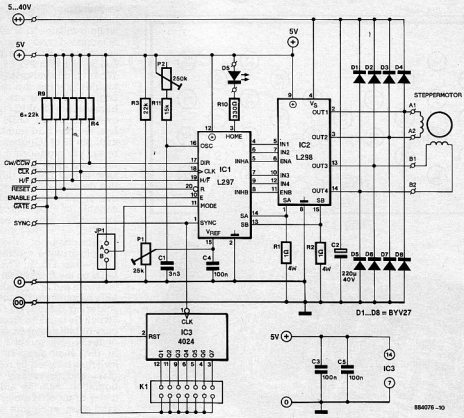
This stepper motor driver is simple without compromising versatility. It has a conventional computer interface, an optional on-board clock generator, and integrated motor control and driver stages. The board can drive dual-stator motors, i.e., motors with two bipolar, or four unipolar, phases. Maximum current per phase is 2A.

The circuit diagram of Fig. 2 shows that the circuit is designed around chip set L297-L298 from SGS.

The block diagram of the L297 is given in Fig. 1. This IC generates control signals for a dual-stator motor, and enables selecting direction of travel and full or half-step operation by appropriate programming of its TTL-compatible inputs. One full or half step performed on the trailing edge of the signal applied to the clock input (CLK). When the enable input, E, is held logic low, the motor is not energized, so that the spindle can be rotated freely. Driv-

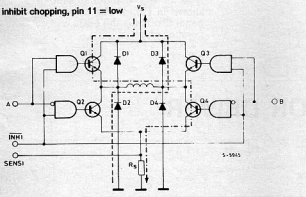


884076 - 11

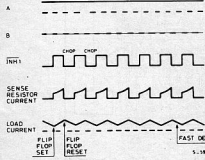


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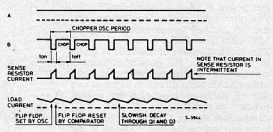
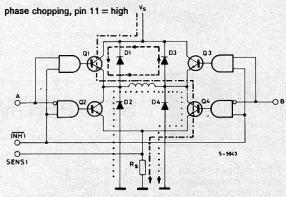
inhibit chopping, pin 11 = low



DRIVE CURRENT
RECIRCULATION



phase chopping, pin 11 = high



Parts list

Resistors ($\pm 5\%$):

R₁, R₂ = 1R0; 4 W
 R₃ . . . R₉ incl. = 22K
 R₁₀ = 330R
 R₁₁ = 15K
 P₁ = 25K or 22K preset H
 P₂ = 250K or 220K preset H

Capacitors:

C₁ = 3n3
 C₂ = 220 μ ; 40 V
 C₃, C₄, C₆ = 100n

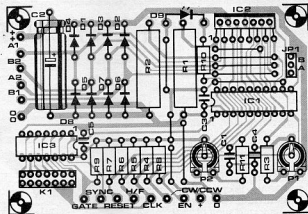
Semiconductors:

D₁ . . . D₈ incl. = BYV27 (Philips Components)
 D₉ = LED
 IC₁ = L297 (SGS)
 IC₂ = L298 (SGS)
 IC₃ = 4024

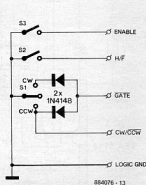
Miscellaneous:

JP₁ = 3-way terminal strip (pitch: 0.1 in.); 1 jumper
 K₁ = 2 off 7-pin terminal strips (pitch: 0.1 in.); 1 jumper
 14 off solder pins dia. 1.3 mm.
 PCB Type 884076

4



5



6



ing the reset input logic low causes the motor to remain halted in the home position (LED D₉ is quenched).

Power driver Type L298 supports constant current drive of the stator windings. Current drive gives good results because it allows stepper motors to be connected to a voltage that is higher than specified for voltage drive. Current drive considerably improves the motor's dynamic characteristics (start frequency and maximum step-rate). An internal oscillator sets a bistable at the start of each period, when the stator windings are connected to the supply voltage. Due to the stator inductance, output current will initially rise linearly, resulting in a linear voltage on current sensing resistors R₁ and R₂. When the measured voltage reaches a certain user-defined peak value, V_{set}, two internal comparators reset the bistables, and the stator current is interrupted. Free-wheeling diodes then reduce the induced stator field. From the above it is clear that current drive works by peak detection. The resultant average current depends on V_{set} (adjustable with P₁), the oscillator frequency (adjustable with P₂) and the values of the sensing resistors. Ripple amplitude on the stator current depends on stator self-inductance and the logic level at the MODE input. When this is high, the outputs of IC₂ are switched to high impedance during the free-wheeling period. The stator field is reduced fairly rapidly via the free-wheeling diodes which conduct because the instantaneous voltage on

the stator winding is slightly higher than the supply voltage. When MODE is held logic low, one transistor in the bridge circuit internal to the L298 remains on during the free-wheeling period. This causes the free-wheeling voltage on the stator winding to remain relatively low, resulting in slower reduction of the stator field strength and, therefore, reduced ripple (phase chopping, see Fig. 3). This option is offered to enable efficient current control of motors with a relatively low stator self-inductance. Synchronization of the oscillators in the L297's is required when multiple drivers and motors are used in a single system. This is simple to accomplish by fitting parts P₂, R₁₁ and C₁ on one driver board only, and feeding the signal available at the SYNC output to the SYNC terminal on the other boards.

An on-board divider, IC₃, is provided to supply the clock signal when the relevant computer output line cannot be programmed to toggle at the required step-rate. The divider is clocked with the SYNC signal of the L297, and jumper block K₁ allows selecting 1 of 7 available clock frequencies (step-rates). On-board clocking via IC₃ can be disabled by driving input GATE logic low. The CLOCK input then functions as an output, enabling the computer to keep track of the number of steps performed. When external clock pulses are applied to the board, IC₃ is simply omitted.

The 5–40 V supply rail need not be regulated — smoothing is adequate

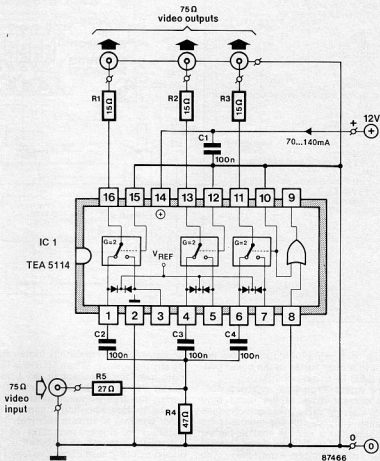
here. The maximum attainable step-rate increase with supply voltage, but 40 V should not be exceeded.

The chopper frequency (refer to Fig. 3), and hence the step-rate in stand-alone applications, is set with P₂. Stator current is set with P₁. Lipping sounds produced by the motor point to instability of the current drive. This effect can be remedied by either re-adjusting the chopper frequency, or by selecting the other logic level at the MODE input of IC₁. When this still fails to stabilize the current drive, the supply voltage must be reduced until the motor operates with voltage instead of current drive. Stand-alone use of the driver is simple to accomplish by connecting three external switches as shown in Fig. 8. Figure 6 shows how to connect the driver board to a unipolar motor. The oscillator inside IC₁ is used only for generating the clock signal required in stand-alone applications of the driver. When it is used, the step-rate can be set by fitting a jumper in the appropriate position on K₁, and adjusting P₂.

Finally, IC₂ is purposely located at the edge of the printed circuit board to enable it to be bolted on a metal surface for cooling.

The Type TEA5114 from Thomson-CSF comprises three electronic switches followed by a buffer/amplifier. Normally the voltage amplification is ~ 2 (6 dB). When the input voltage exceeds $1.2 V_{DD}$ or when the output voltage exceeds $1.5 V_{DD}$, an internal selector reduces the amplification to unity (0 dB). The threshold of $1.2 V_{DD}$ is created with the aid of voltage divider R_4 - R_5 , which also forms the input termination of 75Ω . Series resistors R_1 - R_3 ensure 75Ω output impedance for driving video equipment via standard coax cable. The TEA5114 can be used as a video source selector also, provided each input has its own 75Ω termination network. The non-connected inputs should then be fitted with a coupling capacitor. Channel selection is effected by controlling the logic level at pins 10, 12 and 15. Note that the logic 1 (high) level corresponds to $+2.5 V$ here.

1



2

Parts list

Resistors ($\pm 5\%$): R_1, \dots, R_3 incl. = 150Ω $R_4 = 47 \Omega$ $R_5 = 27 \Omega$

Capacitors:

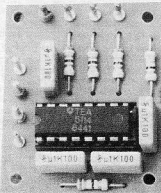
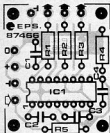
 C_1, \dots, C_4 incl. = $100nF$

Semiconductor:

IC₁ = TEA5114*

Miscellaneous:

PCB Type 87466



This negative voltage converter differs from a host of other designs in not being set up around the latest integrated circuit. The circuit diagram shows that only a handful of commonly available parts are required to build an efficient +5 to -15 V converter.

IC₁ functions as a self-oscillating multivibrator that supplies an output signal with a relatively high duty factor. The LM311 is designed to operate from a single 5 V supply, and has a high output current capability for driving switching transistor T₁. Duty factor of the output signal is determined mainly by voltage divider R₂-R₃, and frequency of oscillation by C₂-R₄. Transistor T₂ forms part of a regulation loop that modifies the oscillator duty factor to maintain -15 V at the output of the converter.

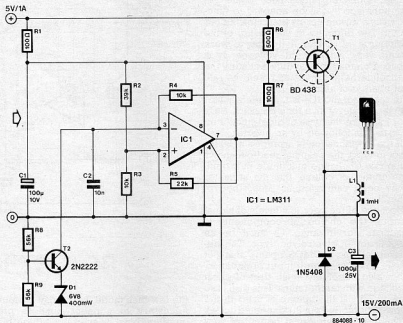
The output voltage, U_o, is calculated from

$$U_o = -(U_{D1} + U_{s-E(T1)})(R_8/R_9 + 1) \quad [V]$$

The component values shown give the following design data:

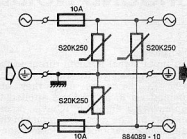
Efficiency (P _o /P _i):	max. 75%
Oscillator frequency:	6 kHz
Duty factor:	approx. 0.8
Output ripple voltage:	100 mV at I _L = 200 mA
Maximum load current:	200 mA

T₁ should be fitted with a small heat-sink.



Source: National Semiconductor Linear Brief 18.

It happens from time to time that very large voltage spikes (lightning; switching of large loads) are superimposed on the mains. Although these spikes are of very short duration, they may have disastrous consequences for mains-operated equipment. A mains power supply can be effectively protected from such spikes with the aid of varistors. These components can handle, but only for a few microseconds, currents of thousands of amperes. In the proposed protection circuit, three varistors are used: one between L(ive) and N(eutral); one between L and E(arth); and one between N and E. The varistors are preceded by fuses, so that only the equipment connected via the circuit is protected. If these fuses were omitted, the entire household supply would be protected with the risk that one of the main fuses blows during an



over-voltage.

The circuit is best built into a small man-made-fibre enclosure with integral plug and socket. The mains-carrying bare wires should be kept separated by at least 3 mm.

FROM ALTIMETER TO VARIOMETER

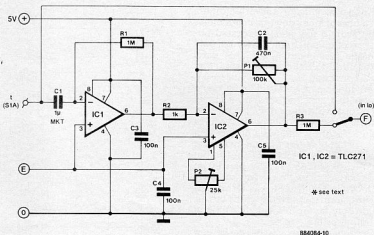
The altimeter published some 18 months ago⁽¹⁾ can be adapted to function as a variometer by the following circuit. The difficulty in the design of the circuit is, of course, that it has to work with very small input voltages. It is based on the fact that differentiating the absolute height gives as result the rate of change of altitude.

In the diagram, IC₁ is the differentiator that operates with a time constant, R₁C₁, of 1 s. Since this type of differentiator inverts, it is followed by an inverter.

If the amplification is arranged at 60 (P₁ set to 60 k), the eventual read-out shows the rate of change of altitude in m/min, assuming, of course, that the altimeter has been calibrated as prescribed in Ref. 1.

Because of the very low levels of signal input, the choice of components is critical. For instance, C₁ must be an MKT, not an electrolytic, type. The differentiator is a CMOS opamp that not only has a very high input impedance, but also extremely small drift of offset voltage with temperature. This drift is so small only if the opamp is used in the low-bias mode (pin 8 connected to +). This has the additional benefit of very low current (typically 10 μA). It also has a disadvantage in that the slew rate is only 0.04 V/μs, but that does not matter here, since for all practical purposes the stage functions as a d.c. amplifier.

Offset voltages are also undesirable in IC₂, because they are added to those of IC₁ and appear amplified at the output. Therefore, P₁ has been incorporated to compensate all offset voltages. Preferably, IC₂ should also operate in



the low-bias mode, but it may be found necessary to connect pin 8 to pin 3 (medium bias) or even pin 4 (high bias) to obtain full offset compensation. This has to be tried out in each and every individual unit. Simply adjust P₂ for a display reading of 000 when the unit is at rest.

The terminals should be connected to the corresponding ones in the altimeter. The switch at terminal F allows selection between altimeter and variometer use. The add-on circuit may conveniently be mounted above or under the altimeter

PCB, and should be well screened.

When the unit is used as variometer, the multiturn potentiometer (P₁) in the altimeter must not be turned. If the unit is used as barometer, the switch should be set to the altimeter position.

Readers should note that the circuit has been tested in laboratory conditions only and NOT in practical use.

BACKGROUND-NOISE SUPPRESSOR

Hiss, crackling, and other discordant sounds are disconcerting and frequent sources of annoyance to most music lovers. Unfortunately, the sources of this background noise are not easy to eliminate, but the circuit proposed here will be of help. It should be appreciated, however, that the suppression of noise is always a last resort: the best way of getting rid of it at source.

The circuit is based on the fact that background noise is always at its most annoying during quiet music passages. It attenuates the output signal by some 45 dB when there is no or very low music signal input. When the input rises, the attenuation decreases proportionally, becoming 0 dB with normal to

loud passages.

The input signal is taken direct to the output terminals via R₁₁ and R₁₂ respectively. At the same time, they are summed via R₁ and R₂ and applied to non-inverting amplifier IC₁ via potentiometer P₁. The cross-over point in the gain characteristic of IC₁ is determined by R₃ and C₁. Frequencies above the cross-over point are not amplified, and so do not contribute to the suppression. The output of IC₁ is rectified by D₁—D₂ and used to switch off T₁. This enables T₂ and T₃ to short-circuit the output and thus suppress the noise signal.

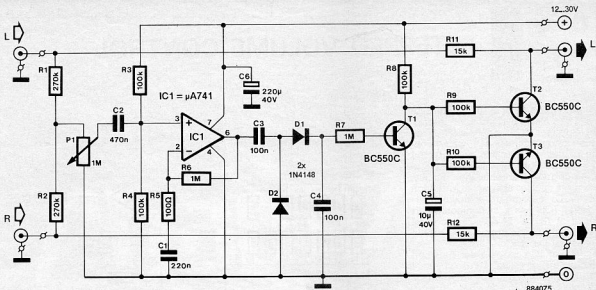
When T₁ begins to conduct, the base voltage of both T₂ and T₃ decreases and the output attenuation is reduced: noise

signals are thus suppressed to a lesser degree.

The sensitivity of the circuit may be varied by P₁: the higher the sensitivity, the sooner the suppression lessens. This allows the sensitivity to be matched to different music sources.

The peak signal level the circuit can handle is about 210 mV. Distortion at that level is not greater than 0.01%.

The delay before the circuit operates is determined by time constant R₁C₁. With values as shown, it is about 1 s but can, of course, be altered to individual taste. The circuit operates from a 12—30 V supply and draws a current of 2 to 3 mA.



884075

D.C. DETECTOR

The d.c. component of a signal can only be detected by separating it from the a.c. component. This is most conveniently done by filtering the a.c. component. In the proposed circuit this is effected with the aid of the common-mode rejection ratio (CMRR) of an opamp. (The CMRR is a measure of the ability of the opamp to produce a zero output for like inputs).

The complete signal is applied to the inverting input of opamp A₁, and only the a.c. component, via C₁, to the non-inverting input. The lowest frequency that can be detected is determined by time constant (R₃ + R₄)C₁. With values as shown, a.c. suppression amounts to about 50 dB at 20 Hz.

The output of A₁ is fed to a low-pass filter to further attenuate high frequencies. This is necessary because the CMRR of an opamp decreases at higher frequencies. The difference signal is then applied to comparator A₂. Diodes D₁ and D₂ ensure that A₂ reacts only to voltages greater than ±300 mV.

A negative direct voltage at the input of the circuit results in a positive potential at the inverting input of A₂, which causes the relay to be deactivated (it is normally energized as long as the 12 V supply is on). A positive direct voltage at the input results in a negative potential at the non-inverting input of A₂, so that, again, the relay is deactivated.

In normal operation, the voltage at the non-inverting input of A₂ is arranged by potential divider R₇-P₁-R₈, so that the relay is energized. Because of C₅, the relay is energized a few seconds after the supply has been switched on.

Capacitors C₃ and C₄ serve to smooth low-frequency signals so as to prevent clattering of the relay.

The relay is driven by a BC547B which can switch currents up to 100 mA. The supply to the relay should be not higher than 18 V.

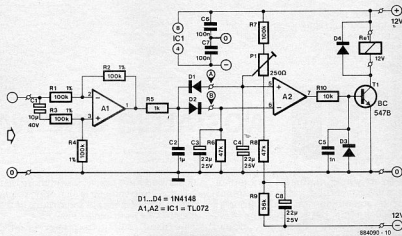
If the circuit is powered by a not entirely symmetrical supply, it may happen that the travel of P₁ is insufficient; the value of R₇ should then be altered as required.

When the circuit is used in an active

loudspeaker system, each output stage should have its own detector, consisting of A₁ and associated components up to points A and B in the diagram. The outputs of these detectors are then connected in parallel to A and B.

For mid- and high-frequency sections of the loudspeaker system the time constant of the input to A₁ may be made smaller to obtain a faster reaction to d.c. components.

Finally, the current drawn by the circuit is determined primarily by the relay.



D1...D4 = 1N4148
A1, A2 = IC1 = TL072

884090-10

STEPPED VOLUME CONTROL

The circuit consists of three distinct sections. The first consists of a straightforward amplifier, IC_{1a} and IC_{1b}. The second is a digital counter, IC₃, which converts a binary code into a resistance value via IC₂. That value is used to control the degree of amplification. Finally, there is a pulse shaper, IC₄, which enables IC₃ to count up or down.

Amplifier IC_{1b} has a switch-controlled gain of 0 dB or 24 dB. The control switch, S₁, is an electronic type driven from output Q_a of IC₃.

The gain of IC_{1a} can be set between 0 dB and 21 dB in steps of 3 dB. The total gain of the two amplifiers can thus be set between 0 dB and 45 dB.

The bandwidth of the amplifier extends from 10 Hz to 40 kHz. The peak value of the amplified signal should not rise above 8 V_{pp} with a supply voltage of 5 V.

The pulse shaper, formed by bistable N₁-N₂ and network C₅-R₁₆, indicates to IC₃ whether it should count up or down. The RC networks suppress spurious pulses.

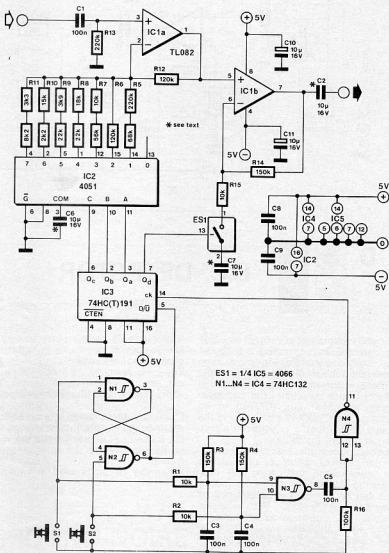
The delay introduced by the RC networks before N₃ ensures that the clock pulse can not appear at the clock input of IC₃ before the direction of counting has been set. The count position can, therefore, be increased or reduced by switches S₁ or S₂ respectively.

Inputs C₂ and D/U of IC₃ may be used to connect a software potentiometer: a two-wire connection per control is sufficient. An 8-bit user port can thus accommodate four of such digital potentiometers.

A standard CD4051 must be used for IC₂, because HC or HCT types do not allow the use of a negative supply voltage on pin 7. The other ICs may be HC or HCT types. If an LS type is used for IC₃, 4k7 pull-up resistors are necessary at the outputs of this circuit to match the voltage levels of the two logic families.

Note that C₂, C₅, and C₇ are bipolar electrolytic types.

The total current drawn by the circuit is about 10 mA.



884065

NOSTALGIC SINE WAVE GENERATOR

As far as young engineers and technicians are concerned, a sine wave generator is something you make from an XR2206. In the pre-IC era, sine wave generators were designed around discrete components. The generator

described here has, however, more than just nostalgic value: It is also educational (and perhaps suitable for writers of the history of electronics).

The (fixed) output frequency is fairly stable at 1 kHz, and the distortion, after

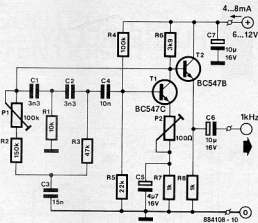
proper adjustment, below 1%. The generator is suitable for use as an audio test generator or as a morse code trainer and costs only a couple of pounds to make.

The generator is of the so-called

double-T type, which has the advantage of not needing any inductors. The oscillator proper, T_1 , is followed by an emitter-follower, T_2 , which ensures a sufficiently low output impedance.

The frequency is set to 1 kHz by P_1 , and P_2 minimizes the distortion of the waveform. With P_2 set for minimum resistance, the amplitude of the output signal will be maximum, but the distortion will be quite appreciable. Increasing the resistance will reduce the distortion, but it may happen that when P_2 is nearing its maximum value oscillations stop. Setting P_2 is thus finding a compromise between acceptable distortion and reliable oscillations. The output level also depends on the setting of P_2 : it lies between 1.5 V_{PP} and 3 V_{PP} .

The circuit may be powered by a 6 to 12 V supply: a PP3 battery (9 V) is perfect. Power consumption is about 48 mW.



FOUR-CHANNEL STEREO SWITCH

The circuit described here enables a choice to be made from four different stereo channels with only one switch. Internal switching is effected by CMOS devices to obviate crackling, bounce, and other annoyances associated with mechanical switches.

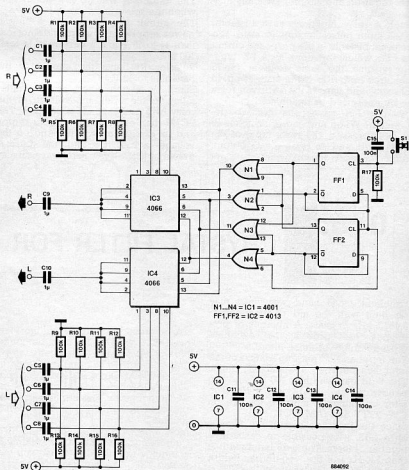
The two D-type bistables in IC_2 are connected as binary dividers by linking their Q output to the D input. The Q output of FF_1 is also linked to the clock input of FF_2 , which results in a kind of four-bit counter.

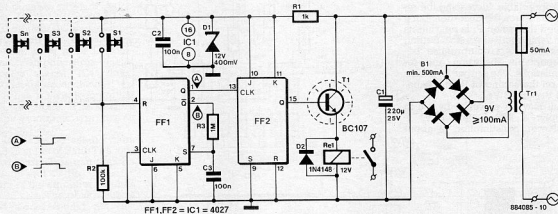
The push-button is connected to the clock input of FF_1 . The four OR gates, N_1 to N_4 , decode the output states of the bistables, so that at all times only one gate has a high output.

The outputs of the gates drive the CMOS switches in IC_3 and IC_4 . The outputs of the four electronic switches in these ICs are strapped together.

The input of each switch incorporates a potential divider, ensuring that the switches operate in their linear regions. This arrangement ensures minimum distortion of the audio signals: the negative parts of these signals would otherwise be distorted, since the switches work from an asymmetrical supply.

The circuit draws a current of only about 1 mA at a supply voltage of 5 V. The supply voltage may be increased to about 15 V.





An alternative to a two-way (or three-way) switch is the so-called pulse relay. This has the advantage that fewer wires are required and simpler switches may be used.

Such a relay functions as a bistable: each input pulse changes its state. The relevant bistable in the proposed circuit is FF₂, which functions as a J-K type. Every time the logic state at pin 13 changes from 0 to 1, the state at pin 15 changes and causes the T-driven relay to be energized or deactuated.

Bistable FF₁ serves as contact debouncer. When any one of switches S₁ to S₄ is pressed, the reset input of FF₁ goes high, and so does the Q output. After a short time (=time constant

R₂C₃), FF₁ is set again. Since the bistable then has a set and a reset signal, the Q output goes high and clocks FF₂. The Q output will go low again only when the relevant switch is released. The circuit is powered by a simple power supply that must provide not less than 14 to 15 V and a current of at least 100 mA.

Resistor R₁ limits the supply to the bistables to 12 V.

Since T₁ is connected as an emitter follower, the operating voltage of the relay will stabilize at some 11 V. The BC107 then operates in its linear region and its dissipation will depend on the voltage across C₁ and the current drawn by the relay. In some cases, it may

be necessary to mount the transistor on a small heat sink.

The relay will switch the mains voltages as required; a type should thus be chosen that can switch 240 V a.c. at about 1 A. The separation of coil and switch contacts should be at least 6 mm. Because the operating switches are completely isolated from the mains, light-duty, low-voltage types may be used.

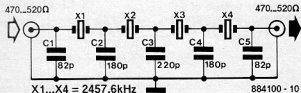
Readers should note that it is not allowed to place the connecting wires to the switches in the same conduit as mains-carrying cables.

CRYSTAL FILTER FOR RTTY

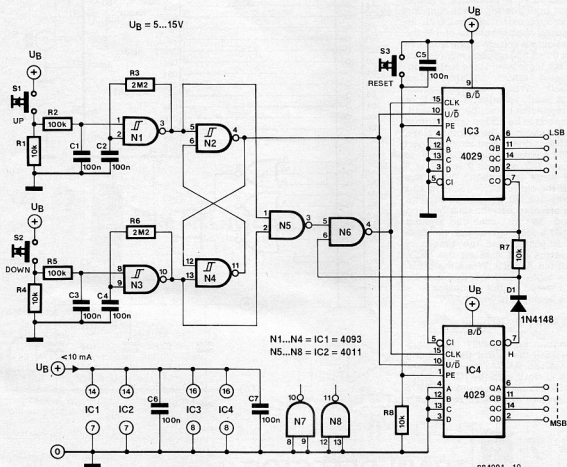
Excellent, small band-pass filters may be built with the aid of inexpensive 2,457.6 kHz crystals. A number of prototypes has proved the excellent reproducibility of these filters.

The input and output impedance of the filter lies between 470 and 520 ohms. The 6-dB bandwidth is 150 Hz, and the bandwidth at -60 dB is 500 Hz. The filter is eminently suitable for use on CW, RTTY, and (AM) TOR.

Since the insertion loss of the filter is only 3 dB, it is possible to cascade a number of them. The 6-dB bandwidth is then 120 Hz and the -60-dB bandwidth is about 240 Hz. Operating with RTTY, it is then attractive to work with 85 Hz shift.



UP/DOWN CONTROL FOR DIGITAL POTENTIOMETER



This circuit enables a digital potentiometer to be controlled manually with the aid of up/down buttons.

The clock signal and count up/down selection for cascaded counters IC3-IC4 are supplied by R-C oscillators N1-N2 and the gate network at their outputs. The 8-bit control word at the output of the circuit is applied to the corresponding inputs of the analogue switches in the digital potentiometer. When all eight bits are used, the control circuit gives a resolution of 1/255th part of the maximum attenuation of the digital potentiometer.

Carry outputs (CO) of the counters are connected to an OR network D1-R7-N6 to prevent the digital word at the output jumping from 0 to 255 or from 255 to 0 when the lowest or highest volume setting is reached. When either IC3 or IC4 reaches its highest or lowest count, N6 inhibits further counting by blocking the clock pulses from N5. Counting down is, of course, still possible from the highest count, 255, and counting up from the lowest count, 0. The volume is set to nought by pressing RESET button S3.

Evidently, the circuit can have more ap-

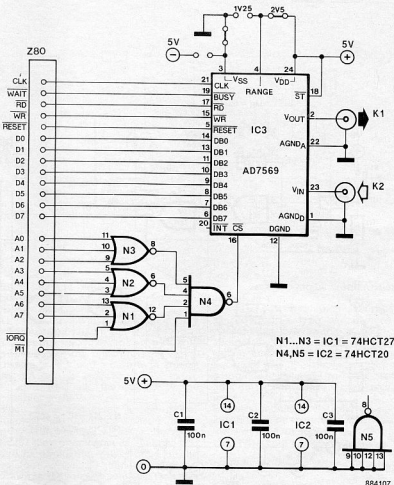
plications than that discussed here. It is, for instance, also suitable as a word generator in computer systems.

EIGHT-BIT ANALOGUE I/O SYSTEM

Analog Devices have in their catalogue a complete 8-bit analogue I/O system on a single chip, the Type AD7569. This IC comprises an analogue-to-digital converter with $2 \mu\text{s}$ conversion time; a digital-to-analogue converter with $1 \mu\text{s}$ conversion time; a reference voltage; and a bus interface for direct coupling to a microprocessor system. With an asymmetrical supply voltage of 5 V, the input and output voltage range from 0 to 1.25 V or 0 to 2.5 V respectively (dependent on the logic level at the RANGE input; widest range available when RANGE=1). When a symmetrical supply is used, voltages of ± 1.25 V or ± 2.5 V respectively can be processed. All that needs to be added is an address decoder as shown in the diagram. Here, the AD7569 is connected to output port 0 of a Z80 microprocessor. Gates N1 to N4 decode I/O address 0 to I/O at a read or write instruction. When this happens, the output of N4 goes low and IC3 is selected. At a write instruction, the data are read into the data bus and converted to an analogue output voltage. At a read instruction, the conversion is started and the processor placed in the wait state via the BUSY output of the AD7569. When the BUSY pin goes high again, the data can be read and stored by the processor. A simple example in MSX BASIC:

```
10 OUT 0, INP (0):GOTO 10
```

This program immediately retransmits (via the DAC) the signal that is being written via the ADC. This shows how easy it is to work with the IC. The AD7569 is manufactured in CMOS and it therefore draws a current of only 12 mA.



TRAIN DETECTOR

In model railways, reed switches are invariably used for the detection of approaching trains. These glass tubes do not look very natural and the corresponding magnets are also relatively large, particularly when N- or Z-scale trains are used. The detection system proposed here offers a much more elegant solution. Trains are detected by ascertaining from which part of the railway track current is drawn.

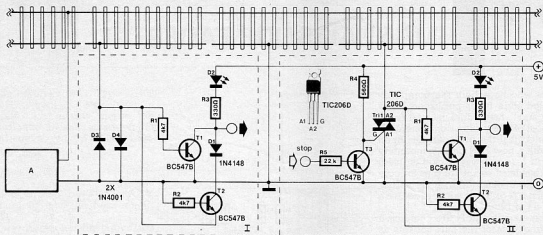
The circuit is suitable for a.c. and d.c. systems, as well as for digitally-controlled model railways. It can be built in two versions. The first one is a simple design with LED indicators and a digital output. The second offers the additional facility of powering a given section of track via a digital control input.

Either way, the complete circuit is small and simple enough to be built in quantity so that all sections of the track can be supplied with one.

The economy version consists of the extreme lefthand part of the diagram. Independent of its polarity, the engine current flows through D₃ or D₄ and causes a p.d. of about 1 V across the diode. Either T₁ will then be switched on via R₁, or T₂ via R₂. This results in the output going logic low and D₂ lighting. Diode D₃ serves to prevent the output voltage dropping below 0 V when T₂ conducts.

The more sophisticated version is shown at the right-hand side of the diagram. In this, the two 1N4001s are replaced by a triac. Normally, this device

is triggered by the current through R₁. The engine current is measured by the p.d. across the a₁ and a₂ pins of the triac. When the input goes high, T₃ is switched on and the gate of the triac is at ground potential. The triac will then switch off. If a locomotive is present in the relevant section of the track, it will stop. It is interesting that the presence of this stationary engine can also be detected, because either T₁ or T₂ will get a base current via the engine. The circuit needs an auxiliary supply for the logic section. If this is chosen at 5 V, the signals generated are TTL and CMOS compatible and may, therefore, be processed by a computer.



884109-10

A = train supply

07 INSTRUMENT AMPLIFIER

An excellent instrument amplifier with differential input may be built from a single, inexpensive Type NE5514 quad-opamp. The circuit shown is a development of the well-known arrangement in the data books of, among others, PMI, Burr Brown, and Analog Devices. The input stages, A₁ and A₂, amplify the difference signal from inputs U₂ and U₁, while the common-mode signal, U_{CM}, is not amplified. If all components are assumed ideal, the output voltages of the input amplifiers are

$$U_A = U_1(1 + 2R_2/R_1) + U_{CM}$$

$$U_B = U_2(1 + 2R_2/R_1) + U_{CM}$$

The difference voltage is then

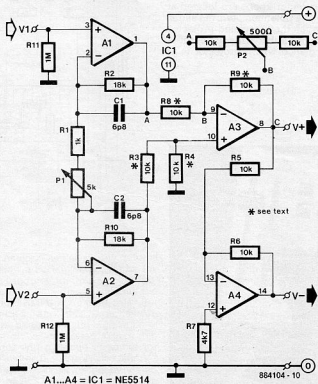
$$U_C = U_A - U_B = (U_1 - U_2)(1 + 2R_2/R_1)$$

This voltage is amplified $\times 1$ in A₃. If a symmetrical output is required, inverter A₄ should be added. Unfortunately, this symmetrical output is not of good quality at higher frequencies, since A₃ introduces appreciable phase shifts.

To obtain good common-mode suppression, it is essential that R₂, R₃, and R₅ are 0.1% types. It is also possible to use a small preset potentiometer between A, B, and C (as shown inset) with which the common-mode suppression can be optimized.

The amplification may be controlled within certain limits by potentiometer P₁.

The supply voltage should not exceed 16 V at which the current drawn amounts to about 6 mA.



* see text

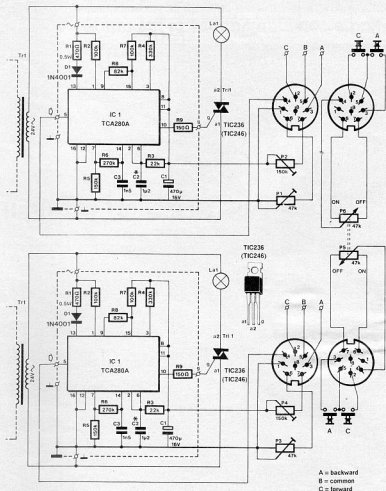
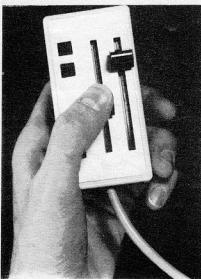
A1...A4 = IC1 = NE5514

884104-10

Readers who have built the computer-controlled slide fader published a few months ago⁽¹⁾, may add a manual fader at the cost of a few extra components. It is assumed that the projector has been fitted with a new DIN chassis-mounting socket. If a 7- or 8-way socket is used, there are at least two spare pins for connecting the manual fader. It should be noted that a 7- or 8-way socket accepts a normal 5-pin plug.

Potentiometers P_5 and P_6 are connected to the free pins of the DIN sockets as shown in the diagram. These potentiometers control the brightness of the lamps in the projectors. The control voltage should be 2.5 to 5 V, and this may be derived from the dimmer PCB as shown in the diagram. To do that, two further preset potentiometers are required in each projector. The additional presets are connected across C_1 in the dimmer circuit, which has a stabilized potential of 12 V. Preset P_1 (P_3) is adjusted so that the projector lamp is at full brightness with P_5 (P_6) fully clockwise. Presets P_2 and P_4 are then adjusted so that the projector lamp is just not out with P_5 (P_6) fully anticlockwise. These adjustments should be repeated a couple of times as the presets affect one another.

The photograph shows how the circuit may be built in a small enclosure. The projector selector knobs are located at that side of the potentiometers the slider points to when the associated projector is dimmed. With this arrangement it is seen at a glance which projector is in use.



LOGARITHMIC READ-OUT

When the well-known Type 7106 voltmeter IC is connected as shown in the diagram, the display shows the logarithmic ratio of the steady input voltages, U_1 and U_2 (where $U_1 \geq U_2$). Expressed as a formula:

$$\text{read-out} = \log(U_2/U_1).$$

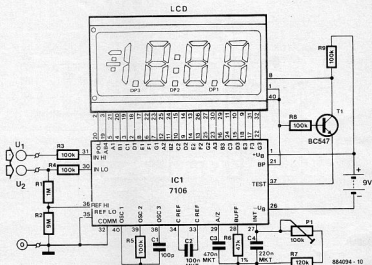
The value of U_1 may be 20 mV to 2 V, while that of U_2 must lie between U_1 and $U_1/100$.

For accurate operation of the circuit, the ratio $R_1:R_2$ must be exactly 1:9.

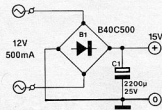
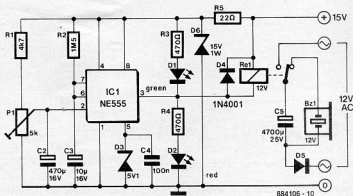
The circuit is set up by applying a direct voltage of 1 V to input U_1 and one of 100 mV to input U_2 , and setting P_1 to a position whereby the display reads exactly 1.000 ($=\log(1/0.1$).

The circuit draws a current of a few milliamperes at 9 V (a PP3 battery is perfect).

(Maxim Application)



POWER MALFUNCTION ALARM



Applications of the well-known Type 555 timer have still not been exhausted as shown in this circuit. It is based on the voltage monitor published some years ago⁽¹⁾. The difference between the two is, however, that the present one measures its own supply voltage and actuates a buzzer which continues to sound after a complete supply failure. The circuit may be added to an existing equipment to detect if and when a power failure occurs.

The 555 functions as a monostable. When the supply is normal, pin 3 of the timer is 0 and this is indicated by D₁

lighting. As soon as the supply voltage drops below a certain value (set by P₁), the 555 is triggered and pin 3 goes high. After about 7 s, D₂ lights to indicate the malfunction. At the same time, relay R₁ is energized, and this switches on buzzer Bz₁, because of the high value of the electrolytic capacitor across the buzzer, this will continue to sound for about 30 s after the supply has failed.

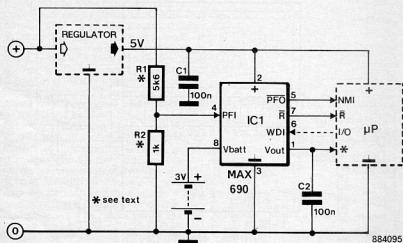
Brief supply variations are not indicated because of the high-value electrolytic capacitor between the wiper of P₁ and ground. Such brief variations in the supply voltage are normally compen-

sated by the reservoir capacitors in the equipment being monitored. If it is desired to detect them as well, C₂ must be omitted.

The alarm delay may be altered to individual taste by giving a different value to R₂ or C₃ (mono time = 1.1R₂C₃).

Dr J. Devasundaram and
Dr Cariappa Annaiah

VOLTAGE MONITOR



The MAX690 from Maxim is a monitor IC for computer PSUs that offers the following facilities.

- Resetting of the processor system by switching the supply voltage on and off.
- Switch-over to back-up battery (for RAM, ROM, or other logic circuits) at mains failure.
- Generating a reset pulse if the on-board timer does not receive a pulse for more than 1.6 s.

- Giving a warning of low supply or battery voltage.

The diagram shows a typical application of the MAX690. The supply voltage is connected to the + terminal (pin 2) and then supplied to the CMOS RAM in the microprocessor via output pin 1. The back-up battery is connected to pin 8. The IC can switch a current of maximum 100 mA.

The \bar{R} (reset) output of the IC is connect-

ed direct to the \bar{R} input of the microprocessor. The Power Fail Output (PFO) of the IC is connected to the NMI input of the microprocessor. The PFO may serve to forecast a mains failure since, if the value of R_1 is correct, this output goes low a few milliseconds before the supply voltage begins to decay.

A reset is given if the supply voltage drops below 4.65 V. The Watch Dog Input—WDI—may be connected to an I/O line of the microprocessor. This input must get a leading or trailing edge at least once every 1.6 s, otherwise the \bar{R} output of the IC is activated. If this function is not required, pin 6 is left unconnected.

The Power Fail Input (PFI) is connected to the junction of potential divider R_1 - R_2 across the unstabilized power supply. With values as shown, the PFI is activated when the unstabilized supply voltage drops below 8.25 V. If a different level is required, the value of R_1 may be calculated from

$$R_1 = R_2(U - 1.25) / 1.25 \text{ ohms}$$

where U is the required level of unstabilized supply voltage.

The IC draws a current of 4 to 10 mA, depending on the output current. When it operates from the back-up battery, it draws a mere $1 \mu\text{A}$.

(Maxim Application)

VERSATILE CONTINUITY TESTER

This simple continuity tester has 4 resistance ranges for quick and reliable faultfinding in electronic equipment. Used with care, the instrument also allows testing diodes, LEDs and electrolytic capacitors.

The four resistance ranges indicated by LEDs are:

- **VLO** = very low resistance = green LED. Resistance between test clips is smaller than 5Ω . Buzzer sounds.
- **LO** = low resistance = yellow LED. Resistance between test clips is between 5Ω and $100 \text{ k}\Omega$.
- **HO** = high resistance = orange LED. Resistance between test clips is between $100 \text{ k}\Omega$ and $15 \text{ M}\Omega$.

- **VHO** = very high resistance = red LED. Resistance between test clips is higher than $15 \text{ M}\Omega$.

The continuity tester can be used for an initial check on the following components:

Diodes: conductive direction: yellow LED; non-conductive direction: red LED. The test current is high enough to enable testing LEDs also.

Capacitors: depending on capacitance, the yellow LED will flash briefly, followed by the red LED lighting continuously.

Electrolytic capacitors: first, the yellow LED lights briefly, then the orange one.

The red LED lights when the capacitor is fully charged. With some skill and experience, the capacitance can be deduced from the charge time. The buzzer produces a continuous or a brief sound when the electrolytic capacitor is faulty.

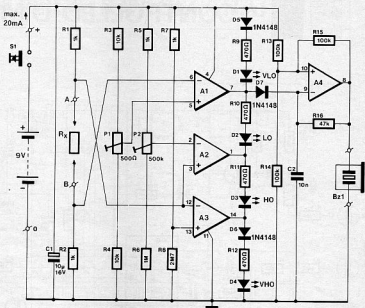
The circuit diagram shows that three operational amplifiers compare the drop across the test leads to a fixed voltage, and indicate which of the two is highest by switching their outputs to the positive supply level or ground — see the accompanying Table. The fourth opamp, A_4 , functions as a rectangular-wave generator for driving the buzzer. The generator is switched on by D_1 ,

because it is only allowed to operate when the output of A1 is low and D1 lights (VLO).

After completion of the continuity tester on the PCB shown, ranges VLO and LO are adjusted with P1 and P2. Clip the test leads to a 5 Ω resistor, and adjust P1 so that D1 just goes out, and D2 just lights. Similarly, use a 100 kΩ resistor for adjusting P2 until D2 and D3 just go out and light respectively.

Current consumption of the tester is less than 20 mA from a 9 V PP3 battery, which should last for 10 to 15 hours of operation. The tester can, of course, also be powered from a mains adaptor. It is recommended to decouple R8 with a 22 μF electrolytic capacitor when the supply voltage is relatively low. To boost the sound output of the buzzer, R16 can be replaced with a preset — adjust this until the buzzer resonates.

	VLO	LO	HO	VHO
A1	0	1	1	1
A2	0	0	1	1
A3	0	0	0	1
LED	D1	D2	D3	D4



A1...A4 = IC1 = TL074

884029

Parts list

Resistors (± 5%):

R1, R2, R5, R7 = 1K0
 R3, R4 = 10K
 R6 = 1M0
 R8 = 2M7
 R9, R10, R11, R12 = 470R
 R13, R14, R15 = 100K
 R16 = 47K
 P1, P2 = 500K preset V

Capacitors:

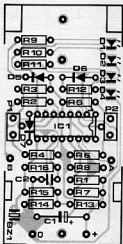
C1 = 10μ; 16 V
 C2 = 10n

Semiconductors:

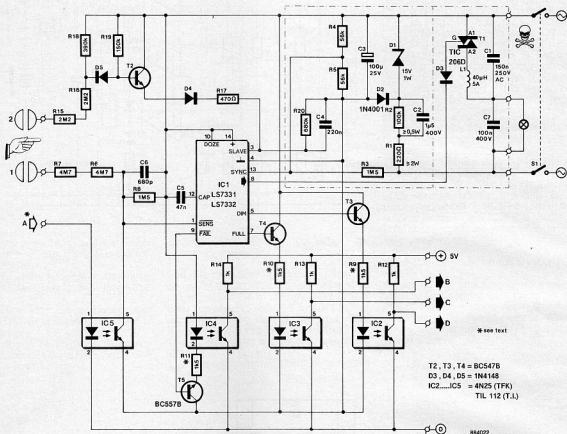
D1 = green LED
 D2 = yellow LED
 D3 = orange or amber LED
 D4 = red LED
 D5, D6, D7 = 1N4148
 IC1 = TL074

Miscellaneous:

S1 = push-to-make button.
 Bz1 = piezo buzzer, e.g. Toko PB2720 (Cirkitt).
 Clip for PP3 battery.
 Suitable ABS enclosure.
 PCB Type 884029



COMPUTER- OR SENSOR-CONTROLLED DIMMER



The central dimmer chip in the circuit, an LS7331 or LS7332, accepts control commands from a sensor (number 1 or 2) and from a computer (input A).

The load is powered when the sensor is briefly touched (between 39 and 339 ms). Depending on the type of controller used, applied power is then maximum (LS7331), or equal to the last set value (LS7332). The next touch on the sensor switches off the load. When the sensor is touched longer than 339 ms, IC1 slowly varies the lamp intensity between maximum and minimum. Lamp intensity is selected — and retained — simply by releasing the sensor in the appropriate instant. All control operations are synchronized to the mains frequency by a phase-locked loop in the controller chip. Inputs 1 and 2 are functionally equivalent,

but the use of input 2 is preferred over input 1 when the sensor is connected to the circuit by means of a cable. Input A makes it possible to control all functions by means of a computer. The dimmer chip sends its status to the computer via outputs B, C and D (mains failure; minimum phase angle; dimmer active).

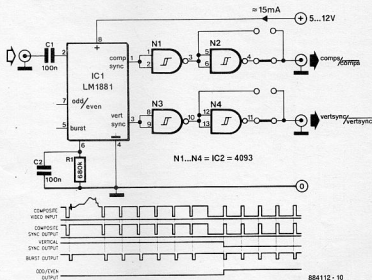
Operation of the circuit is relatively simple. Components D1-D2-R1-R2-C2-C3 form a 15 VDC supply for IC1. Capacitor C7 ensures that this supply continues to operate when relatively light loads (< 25 W) are controlled at large phase angles. In the interest of safety, series-connected resistors R15-R16 and R7-R8 may not be replaced with single 4M7 and 10M types respectively. The value of R9, R10 and R11 may have to be changed when other optocouplers than

the 4N25 are used. To prevent the supply voltage for IC1 dropping below 15 V, these resistors must not be made smaller than 680Ω. The total current consumption of the LEDs in the optocouplers should remain below 25 mA. The 5 V supply for the associated transistors is provided by the computer via terminals +5 V and 0.

Finally, an important note on safety: the necessary insulation between the user and the mains can only be ensured if the dimmer is fitted in a sealed ABS enclosure.

SYNCHRONISATION SEPARATOR

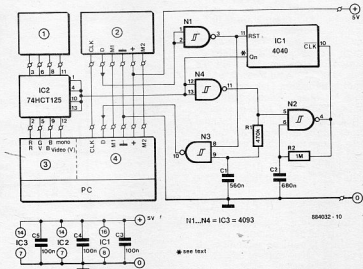
The Type LM1881 from National Semiconductor is a synchronisation separator that has already found its way in numerous commercial applications. Practical use of the chip is straightforward, because the number of external components is kept to a minimum. The R-C network at pin 6 controls the internal timing of the chip, and the width of the synchronisation pulses at the outputs. In the sample circuit, the R-C constant is dimensioned for a TV line frequency of 15,625 Hz. The input of the circuit can be driven with composite video levels between $0.5 V_{DD}$ and $2 V_{DD}$. Gates N_2 and N_4 are provided to enable driving monitor inputs that require inverted sync signals. The amplitude of these is determined by the supply voltage — when 5 V is used, TTL-compatible inputs can be driven direct.



BURN-IN PROTECTION FOR PC SCREENS

Many computer users are in the habit of abandoning their machine for several hours without turning it off, or at least reducing the display intensity. This negligence readily leads to text or images permanently burned into the phosphor layer of the screen. There exist memory-resident programs that detect the prolonged absence of keyboard actions, but compatibility with the main program is often a problem. The hardware solution presented here is reliable, and should work with most IBM PC-XTs and compatibles.

The circuit effectively sits between the keyboard and the computer, and between the computer and the monitor. A CMOS switch breaks the connection between the computer and the monitor when no keyboard action is detected for some time. To prevent having to cut existing cables, the circuit is mounted in a small box fitted with the appropriate sockets and connectors. The supply voltage is obtained from the keyboard. Counter IC_1 is reset by data from the keyboard. When the data flow stops, the count output of IC_1 goes high after a predetermined period. This causes IC_2 to switch to high-impedance, so that keyboard data is blocked by N_3 . When any key is pressed, IC_1 is reset, and the connection between video output and

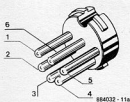


- ① monitor
- ② keyboard
- ③ video output
- ④ keyboard input

monitor is restored. The first keyboard code is not transferred to the computer, because N_3 blocks data as long as C_1 is not discharged. This arrangement ensures the suppression, on the monitor, of the first, arbitrary, character typed on the keyboard to restore the video connection.

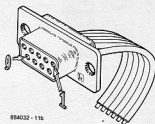
The screen saver was tested on an Amstrad PC1640SD and a monochrome monitor (Hercules-compatible video mode). For computers with a CGA, it is probably necessary to break the intensity, rather than the video, signal. With PC compatibles other than the Amstrad, the logic levels on the keyboard data line are inverted. To be able to use the circuit with these machines, insert inverter N_1 between the output of N_3 and the keyboard input of the computer. The 'display-off' delay can be selected as follows:

Q11 (pin 1)	11 min.
Q10 (pin 15)	5 min. 30 s
Q9 (pin 14)	2 min. 45 s
Q8 (pin 12)	1 min. 22 s
Q7 (pin 13)	42 s



PC-XT: pinning of keyboard connector

Pin	Assignment
1	keyboard clock
2	keyboard data
3	mouse button 1
4	ground 5
5	+5 V
6	mouse button 2



PC-XT: pinning of video connector

Pin	Assignment
1	ground
2	secondary red or ground
3	primary red (R)
4	primary green (G)
5	primary blue (B)
6	secondary green or intensity (I)
7	secondary blue or mono video (V)
8	H-sync
9	V-sync

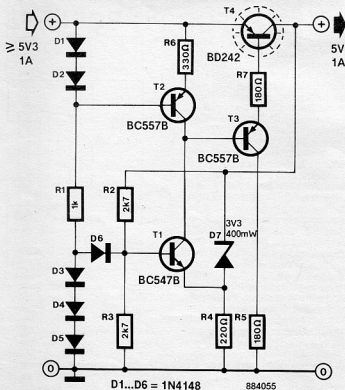
08 DISCRETE VOLTAGE REGULATOR

Low-drop voltage regulators can aid in saving energy by keeping dissipation in power supplies low. Unfortunately, integrated low-drop regulators with an output current capability of more than about 0.4 A are hardly found on the market. The low-drop series regulator shown here is intended for all applications where more than 0.4 A is required, and supply dissipation is to be kept as low as possible.

Constant-current source T_2 - D_1 - D_2 - R_6 ensures high amplification and adequate suppression of hum and noise on the raw input voltage. T_3 and T_4 form a kind of darlington transistor. This is driven by T_1 , whose base and emitter terminals are connected to the output voltage.

When this rises, the emitter potential rises above that of the base. The transistor blocks, so that the control voltage for T_3 - T_4 , and with it the output voltage, is reduced. Diodes D_3 to D_6 serve to supply the start voltage for this regulator circuit.

The output voltage is determined by D_7 and R_2/R_3 . Resistor R_2 can be replaced with a 5K0 preset to compensate the (usually fairly large) tolerance on the zener diode. It should be remembered that the circuit has no current limiter, so that it is not short-circuit resistant.

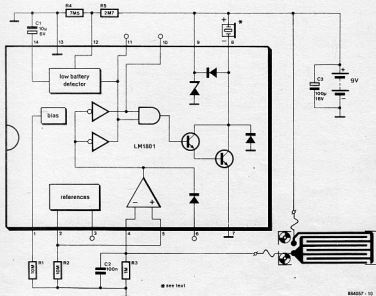


WATER ALARM

This circuit gives a loud warning when even the tiniest amount of water is detected on a special humidity sensor. When this is installed in a suitable location, the circuit provides an early warning before a defective pump, leaking drainage system, water supply, washing machine or dishwasher can flood the bathroom, cellar or kitchen floor. There exist self-locking valves and automatic switch-off systems to prevent flooding, but these are, in the main, not sensitive enough to afford the degree of protection required, i.e., they are not actuated until the domestic calamity is actually taking place.

The circuit is an application of the low-power comparator Type LM1801 from National Semiconductor. The reference voltage for this IC is set with R_2 . When the voltage at pin 4 of the chip exceeds the set threshold due to the sensor becoming wet or humid, the chip drives the active piezoelectric buzzer with a current of no less than 24 mA.

Stand-by current consumption of the circuit is about 10 μ A, so that a 9 V PP3 battery should last for about 1 year. Finally, it is, of course, possible to connect multiple sensors in parallel.



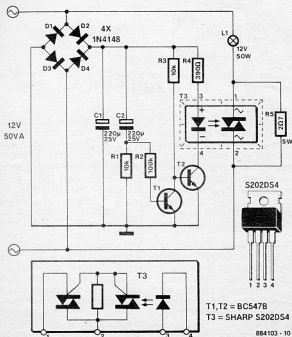
8845P-10

SOFT-START FOR HALOGEN LAMPS

This simple circuit extends the life of halogen lamps in slide or film projectors by eliminating the sudden temperature increase in the lamp filament when this is still cold, and forms a very low resistance.

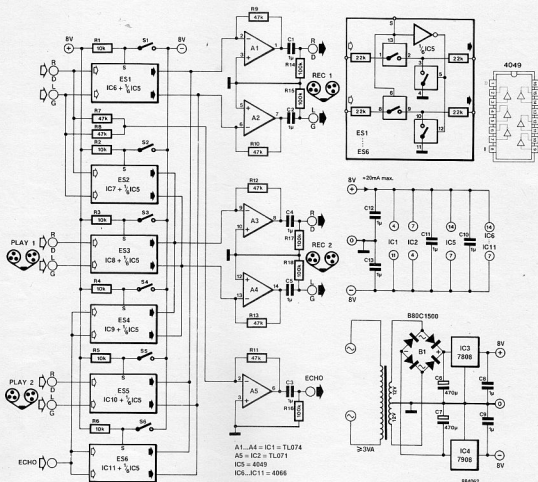
Capacitor C_2 is discharged yet when the lamp is switched on. This means that T_1 conducts, T_2 blocks, and the optocoupler-triac is not activated. The initial filament-heating current is limited to a safe 4 A or so by resistor R_3 , which shunts the triac. Meanwhile, C_2 is charged, so that the base voltage of T_1 drops. This transistor is turned off, so that T_2 starts to conduct. The crux of the circuit is that the LED in the opto-triac causes the triac to be fired only during the zero-crossings of the alternating supply voltage. Shunt resistor R_3 is then effectively short-circuited, and the lamp lights at full intensity.

The opto-triac should be fitted on to a large heat-sink. Maximum output current of the circuit is about 8 A.



T1, T2 = BC547B
T3 = SHARP S202D54

884103-10



The problem is well-known: the more signal sources, the higher and more tangled the heap of interconnecting wires, and the more hum on recorders. This circuit can aid in avoiding these difficulties and the awkward situations that arise from them. The modular structure of the signal divider allows it to be laid out to individual requirement (the circuit diagram shown is but a suggested configuration).

The signal divider shown should be capable of mastering relatively complex equipment set-ups thanks to its two tape recorder inputs, echo input, and auxiliary input. In the sample circuit, six switches are used for routing the signals. The function of these switches is summarized in Table 1.

The symmetrical 8 V power supply of the circuit is a conventional design that

merits no further discussion. The internal structure of 'black boxes' ES₁ to ES₆ is shown in the top right-hand corner of the diagram. Each channel comprises two pairs of electronic switches which are controlled in complementary fashion by the logic level applied to input S. When this is driven positive, the horizontal (series) switches are closed, and the vertical (shunt) switches opened. This situation is reversed when input S is made negative (S_x closed). Prototypes of the switching units achieved a cross-talk level of -85 dB and a channel separation of more than 75 dB. Signal-to-noise ratio was more than 100 dB, and distortion less than 0.01%.

The left and right channel of the auxiliary input are joined with R₇ and R₈. The monaural signal so obtained is then amplified in A₅ and fed to the echo

send socket. Amplification of the opamps is defined by the feedback resistor (R₉ to R₁₃).

The low current consumption of the signal divider (20 mA), makes it possible to replace the mains supply with a pair of 9 V batteries if the unit is not used frequently.

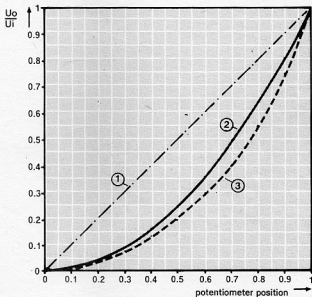
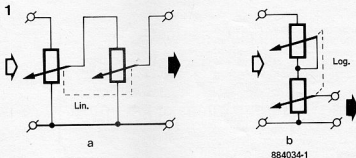
Switch Function

S1	Input to tape 1 (record)
S2	Input to tape 2 (record)
S3	Tape 1 (playback) to tape 2 (record)
S4	Echo (input) to tape 2 (record)
S5	Tape 2 (playback) to tape 1 (record)
S6	Echo (input) to tape 1 (record)

Tracking of many types of inexpensive logarithmic stereo (dual-axis) potentiometer is usually very poor, and gives rise to audible volume differences in stereo AF amplifiers. This article presents two alternatives for making a stereo logarithmic volume control with adequate tracking characteristics.

To begin with, linear stereo potentiometers may be used. Plotting resistance as a function of spindle position, the single elements in linear stereo potentiometers give a straight line, marked 1 in the accompanying graph. Curve 2 is obtained when the individual potentiometers are connected in series, and curve 3 when they are connected as shown in Fig. 1a. The latter two curves correspond to a pleasant and natural sounding volume control: with the potentiometer set to the centre of its travel, the attenuation is about 5, against about 10 for a standard stereo logarithmic potentiometer.

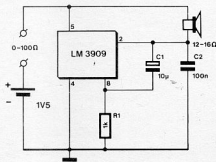
The response of the volume control is also improved by the use of a stereo logarithmic potentiometer connected as shown in Fig. 1b. This configuration enables an additional attenuation of about 6 dB to be achieved in the first part of the control range. This attenuation decreases gradually as the spindle is advanced.



884034-2

The size of this continuity tester can be kept very small thanks to the use of a 1.5 V penlight battery. The miniature loudspeaker sounds when the resistance between the test clips (or probes) is between 0 and 100 Ω . Differences of 5 Ω are translated in a corresponding change of the output volume.

The battery has a relatively long life expectancy because current consumption of the continuity tester is only 30 mA when the test inputs are short-circuited.



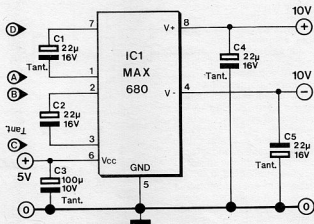
884059-1

SYMMETRICAL VOLTAGE DOUBLER

Many circuits based on operational amplifiers and comparators require an auxiliary, low-power, symmetrical power supply. The circuit shown here is an asymmetrical-to-symmetrical step-up converter, which is ideal for use in digital equipment, whether battery-powered or with a large 5 V supply, but lacking symmetrical rails for feeding opamps. Cost and space requirement of the converter should compare favourably with an add-on symmetrical supply requiring a separate transformer, rectifier, smoothing and regulation parts.

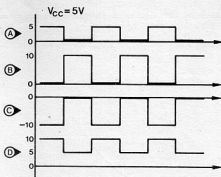
The circuit diagram demonstrates the simplicity of the voltage doubler, which is an application of the recently introduced Type MAX680 from Maxim Integrated Products Inc.

Output impedance of each symmetrical rail is about 200 Ω , and maximum current about 10 mA. In the quiescent condition, the chip consumes hardly any current at all, and ripple on the output lines is then only 40 mV_{pp}.



884058-10

V _{CC} = 5 V f _{osc} = 11.5 kHz load = 1 k Ω			
condition	V ₊	ripple	efficiency
V ₊ and V ₋ not loaded	V ₊ + 9.92 V V ₋ - 9.90 V	40 mV _{pp} (spikes) 30 mV _{pp} (spikes)	n.a. n.a.
V ₊ loaded V ₋ not loaded	V ₊ + 8.57 V V ₋ - 8.46 V	60 mV _{pp} 30 mV _{pp} (spikes)	82%
V ₊ not loaded V ₋ loaded	V ₊ + 8.82 V V ₋ - 7.78 V	80 mV _{pp} 60 mV _{pp}	74%
V ₊ and V ₋ loaded	V ₊ + 7.53 V V ₋ - 6.69 V	100 mV _{pp} 60 mV _{pp}	70%



884058-11

AUTOMATIC VOLUME LIMITER

This circuit limits the output power of an AF amplifier when predefined levels of amplitude and frequency of the output signal, or current consumption, are exceeded.

Current consumption of the amplifier is measured with R_x. Transistor T₁ conducts and drives the volume limiter, T₂, when the drop across R_x exceeds 0.56 V. The limiter reduces the amplitude of the AF input signal by shunting this with a variable resistance formed by a light-dependent resistor (LDR), which is illuminated by LED D₂.

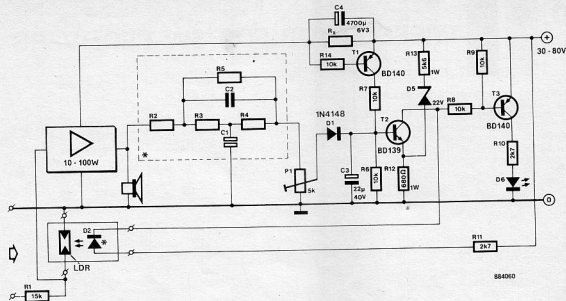
The T-filter connected to the loudspeaker output of the amplifier can also actuate the volume limiter via preset P₁,

which thus allows setting the onset point of the limiter as a function of output signal amplitude and frequency. The Table shows the configuration of the filter for three ranges of amplifier output power. Capacitor C₁ is a bipolar type. The filter is laid out to respond to low and high frequencies to prevent the woofer and tweeter in the loudspeaker box being overloaded.

The emitter of T₂ is held at a reference potential that follows the supply voltage of the amplifier. Supply voltage fluctuations thus have a direct effect on the bias setting of T₂. This does not conduct until the threshold of 0.6 V between base and emitter is exceeded. LED D₂

lights to indicate that the onset level of the limiter has been reached. When D₂ lights at maximum brightness, it is impossible to use the relevant control on the amplifier for turning up the volume further.

The LED and LDR are fitted in a small, light-resistant enclosure, e.g. a film container. A single LED (D₂) enables an attenuation of 18 dB to be achieved. This can be increased to 20 or 23 dB by fitting one or two LEDs in series with D₂. Distortion of the input signal is low, and feedback problems that often arise in FET-based circuits should not be encountered. Series resistor R₁ is dimensioned in accordance with the required



884060

response of the limiter, and the signal level and impedance at the input of the amplifier.

It should be noted that the proposed limiter is relatively slow. This disadvantage is caused by its response delay of about 100 ms. The circuit can be simplified to limit voltage peaks only by

omitting the filter section, and applying the loudspeaker signal direct to P1. Current consumption of the limiter with D₂ and D₅ on is about 35 mA at a supply of 40 V.

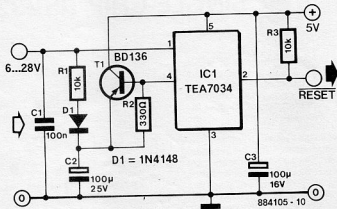
FILTER						
P	R2	R3	R4	R5	C1	C2
< 25W	680Ω	1k5	1k5	1k5	10μ	150n
25-50	1k	2k2	2k2	3k3	5μ	100n
> 60	1k5	2k7	2k7	5k6	4μ7	68n

09

NOISE-RESISTANT 5 V POWER SUPPLY

The recently introduced integrated voltage regulator Type TEA7034 from CSF-Thomson has been specifically designed for use in microprocessor-based circuits whose operation can be expected to suffer from noise, spikes and digital interference.

After power-on, the regulator supplies a delayed RESET pulse to the microprocessor. The timing of this pulse depends on the values of R₁ and C₂. In the application shown, the delay is about 0.6 s. The regulator is capable of withstanding input voltage peaks of up to 80 V. When the output voltage drops below 4.75 V, shunt regulator T₁ is switched on, and C₂ acts as a current buffer that temporarily feeds the load. Once the regulator is powered-up, the raw input voltage is allowed to drop to 6 V without affecting the stability of the output voltage. It should be noted, however, that the RESET output does not toggle properly unless the input voltage is greater than about 8 V. RESET remains low at lower input voltages, with R₃ functioning as a pull-up resistor. The circuit introduces a voltage drop of



only 0.6 V at the maximum output current of 500 mA (the short-circuit output current is 800 mA). Voltage regulation at the 5 V output is to within 2.5%. Reversed input voltages of up to -18 V at the

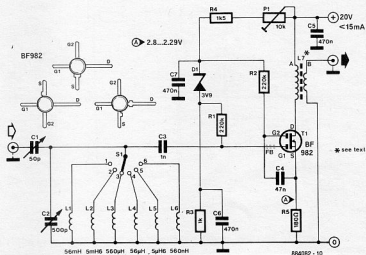
input do not harm the IC, which is short-circuit resistant as well as protected against thermal overloading.

The low input capacitance of modern dual-gate MOSFETs makes it possible to realize negative feedback by means of a non-decoupled source resistor. If properly applied, this technique enables making an RF input stage with a relatively high dynamic range. No short-wave radio amateur needs to be told that good large signal handling capabilities are a must these days to prevent receiver overloading and cross-interference caused by very strong signals.

Unlike input sections in many top-class SW receivers, this circuit has no problems handling RF input signals of up to 2.5 V_{pp} (not uncommon during nighttime reception, and when a good aerial is used). The output then supplies 3 V_{pp} when terminated in 50 Ω.

Tuning capacitor C₁ determines the overall gain, which is mostly due to resonance in the L-C network at the input of the circuit. The maximum drain current that may be set by P₁ is 12.7 mA, corresponding to 2.29 V on R_s. The minimum drain current is 10 mA (U_{RS} = 1.8 V).

The six input inductors are wound on high-quality ceramic formers with a diameter of at least 10 mm. The ferrite bead is slid direct onto the gate 1 terminal of T₁ to prevent parasitic oscillation in the VHF or UHF band. Output inductor L₇ is wound as 20 turns (A) and 4 turns (B) on a Type G.2-3/FT16 ferrite ring core.



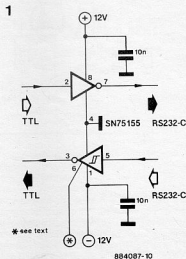
The frequency ranges of the active input selector are:

- 1: 30...100 kHz
- 2: 100...300 kHz
- 3: 300...900 kHz
- 4: 900...2700 kHz
- 5: 2700...9000 kHz
- 6: 9000...30 000 kHz

SINGLE-CHIP RS232 TRANSCEIVER

There are many applications in which only one RS232-C line is perfectly adequate for serial communication between computer equipment. In these cases, it is often tempting to resort to the use of the well-known integrated circuits Type 1488 and 1489, which are a quadruple RS232-C line driver and receiver, respectively (the equivalent types from Texas Instruments are SN75188 and SN75189). This solution is uneconomical, however, because two chips are required, in which no fewer than six line interfacing devices remain unused. Also, +5 V is required in addition to ±12 V.

The new Type SN75155 from Texas Instruments houses an RS232-C line driver, a receiver and a 5 V converter, which makes it possible to feed the chip from a symmetrical 12 V supply. The receiver is provided with a response input, which can be connected to a resistor, or a resistor and a bias voltage, for

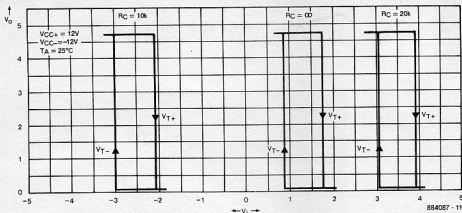


noise filtering and optimizing the response for relatively high baudrates and non-standard swings of the input signal. Dimensioning data for the resistor, R_c, connected to pin 6 can be deduced from the curves in Fig. 2. It is seen that R_c allows the input threshold of the receiver to be shifted over about 6 V to ensure correct response to the received signal:

- left-hand curve: receiver input threshold with R_c = 10 kΩ fitted between pin 6 and pin 1;
- centre curve: response input not connected;
- right-hand curve: receiver input threshold with R_c = 20 kΩ fitted between pin 6 and pin 8.

Noise rejection of the receiver can be defined by fitting a capacitor, C_c, at the response input. The curves in Fig. 3

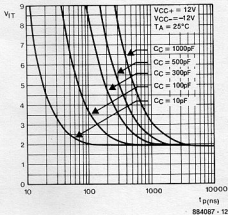
2



show the input threshold voltage, V_{T+} (y-axis), as a function of pulse duration, t_p (x-axis), with C_c as a parameter. It is seen that C_c effectively raises the input threshold for pulses with a relatively short duration. Hence, needle pulses (noise) superimposed on the received RS232-C signal can be prevented from causing digital pulses at the output of the line receiver.

The input of the line driver in the SN75165 is TTL compatible. The line driver has a current-limited output ($I_{max} = 10$ mA). Current consumption of the chip is 10 mA typical, exclusive of the line current.

3



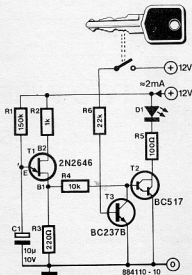
DECEPTIVE CAR ALARM

This circuit is intended to trick car burglars into believing that the vehicle is fitted with an alarm system. A LED, fitted at a suitable location on the dashboard, flashes at very high brilliance. This is achieved by feeding it with a pulsating current of about 100 mA, which is far more than permissible for continuous operation. The circuit is based on a relaxation oscillator set up around unijunction transistor (UJT) T_1 , which supplies repetitive pulses with a duration of a few milliseconds to darlington transistor T_2 . Via T_3 , the LED flasher is turned off when the ignition is switched on.

Due to the low duty factor of the pulsating current, the circuit has an average current consumption of only 2 mA. Resistors R_1 and R_3 may have to be redimensioned to compensate the relatively high production tolerance on UJTs. High-efficiency LEDs are not suitable for use in this circuit, and care should be taken not to exceed a peak current of 250 mA.

Finally, it may be a good idea to fit the LED near the car radio, and to secure adhesives on the side windows of the vehicle warning of the presence of an alarm system.

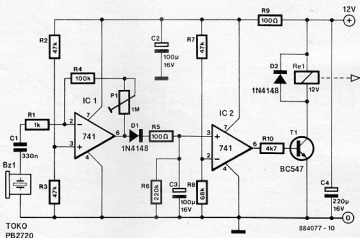
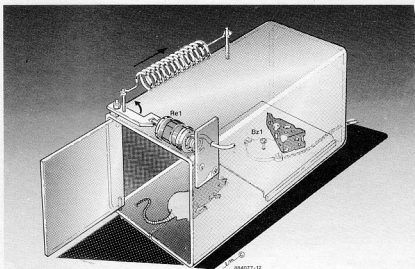
2N2646



ELECTRONIC MOUSETRAP

This is an animal-friendly design, whose operation is apparent from the drawing and the circuit diagram. A piece of cheese is put on a piezoelectric buzzer fitted in the mousetrap fitted in the mousetrap. When the mouse approaches the cheese, and trips on the buzzer, an electric signal is generated. This signal is raised in a high-gain amplifier, IC₁, whose rectified output signal is used for controlling a relay. When a predefined sound level is exceeded, the relay is energized, a spring-operated lever is released, and the door of the mousetrap is closed. The complete box can then be taken out of doors to release the animal.

The sensitivity of the sensor can be increased by fitting a small screw and metal plate on to the crystal element. The metal plate should have some play to ensure a soft rattle on the buzzer surface when this is tripped on by the mouse's feet. Preset P₁ is the sensitivity control.



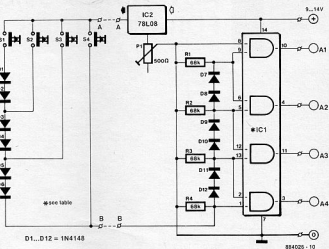
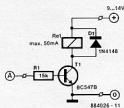
TWO-WIRE REMOTE CONTROL

This circuit enables 4 devices to be remote-controlled via a two-wire cable installed, for instance, between the cellar and the attic in the home. Operation is simple: pressing switches S₁ to S₄ selects the corresponding output, A1 to A4, at the receiver side. The regulated voltage supplied by IC₂ is carried by one of the wires (A) in the

cable. At the 'transmitter' side, this voltage is reduced by the drop across two, four, or six diodes, and fed back to the receiver via wire B, when S₃, S₂ or S₁ is pressed respectively. When S₄ is pressed, wire B carries the full output voltage of IC₂. Circuit IC₁ translates the returned voltage into a corresponding bit combination at outputs A1 to A4.

The circuit is adjusted by pressing S₄ and turning P₁ until output A4 just toggles. A number of pin-compatible CMOS ICs can be used in position IC₁ — see the Table for the resulting configurations of switches and outputs. Outputs A1 to A4 can sink 1.1 mA (logic low), and supply 0.4 mA (logic high). The relay driver shown can handle coil cur-

rents of up to 50 mA.
In spite of its simplicity, the circuit ensures reliable 4-way remote control with cable lengths up to 50 m.



	4001 4071	4011	4070	4077	4081
S1	1	-	1	1	-
S2	1+2	1	2	2	1
S3	1+2+3	1+2	3	3	1+2
S4	1+2+3+4	1+2+3	4	4	1+2+3
Output	L	L	H	L	H

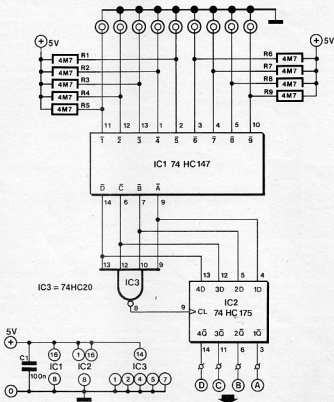
0 9 9-CHANNEL TOUCH-SENSITIVE SWITCH

This circuit exploits some of the technical characteristics of the 74HC series of CMOS integrated circuits. Contrary to standard CMOS devices, those in the 74HC series are TTL-compatible. Another benefit is that they are less prone to oscillation.

The 9-way touch-sensitive switch is simple to build from only 3 ICs and a handful of resistors. Circuit IC1 is a 10-to-4 channel priority encoder. By virtue of its high input impedance, the 74HC147 allows 4M7 resistors to be used for creating a logic high level at the sensor inputs. When one of these is touched, the resultant low resistance to the circuit ground causes IC1 to read a logic low level.

When several sensors are touched simultaneously, the priority encoder supplies the 4-bit code that corresponds to the sensor with the highest number. In the de-activated state, all outputs are logic 1.

The output code of the priority encoder is latched in quad bistable IC2 — the latch pulse is supplied by NAND gate IC3. When none of the sensors is touched, IC3 supplies a logic low level because the input pattern is 1111. When IC1 supplies at least one logic 0, the NAND output toggles, and the 4-bit code is latched in IC2. The state of the bistable is not changed until the encoder is returned to the de-activated state, and a sensor is touched afterwards.



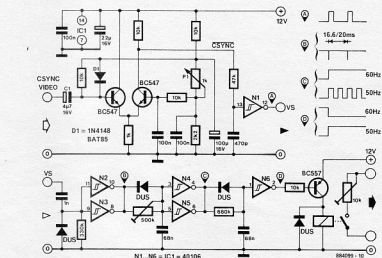
884061-10

AUTOMATIC 50/60 HZ SWITCH FOR MONITORS

It sometimes happens that a computer program can not be used in a particular country because it supplies the wrong field frequency for the TV set or monitor. Unfortunately, it is not always possible to change the field frequency from, say, 60 Hz (American standard) to 50 Hz (European standard) by using a conversion patch in the video driver. A possible, but not particularly elegant, solution to this problem is to re-adjust the field synchronisation control in or on the TV set to stop the picture from rolling vertically. The circuit shown here performs this task automatically.

The field frequency switch can be built into the monitor or TV set, but ONLY IF THIS HAS A BUILT-IN POWER TRANSFORMER THAT GUARANTEES COMPLETE INSULATION FROM THE MAINS. The circuit has a current consumption of only 30 mA, and is conveniently fed from the supply in the TV set. The input signal can be composite video or just composite sync. The preset drawn near the relay shunts the field frequency control in the TV set when the relay is energized following the detection of 60 Hz field synchronisation pulses. It may not be possible in all cases to simply shunt the existing control in the TV set, but this problem can be resolved by the use of a relay with one or more change-over contacts.

The two transistors at the input of the circuit form a differential amplifier that functions as a comparator. The base potentials are, in principle, equal when P_1 is set to 0 V. Parts C_1 and D_1 cause the blanking level of the video signal to be shifted such that the synchronisation pulses are at 0.5 V below the base reference potential (switching threshold). To allow the circuit to work with video signals of 1 V_{pp}, the switching threshold can be adjusted with P_1 . The amplitude



of the sync pulses is 30% of the full swing of the composite video signal, i.e., 0.3 V, so that the switching threshold is optimum when set to $0.5 \times 0.3 = 0.15$ V. The comparator is followed by an integrating network that eliminates the horizontal sync pulses. The next stage in the circuit is a differentiator for the vertical sync pulses (50 or 60 Hz), which are given a fixed width.

When the pulse train so obtained is integrated further, the average amplitudes can be arranged to lie just under and above the switching threshold of a Schmitt-trigger. In practice, it is more favourable to use a low time-constant for the integrator, so that the output sup-

plies 50 Hz pulses, or a direct voltage when the circuit is driven with a 60 Hz signal. This arrangement alleviates the difficulty in accurately setting the switching threshold, and requires only one more integrator to eliminate the 50 Hz pulses. The digital signals so obtained are simple to use for controlling a relay.

Adjustment of the circuit is simple: apply a 60 Hz video signal and adjust the threshold (500 kΩ preset) until the relay is actuated. Then adjust the additional field frequency preset until the picture is steady. Diodes marked DUS are general-purpose, small signal, silicon types, e.g. IN914 or IN4148.

FOX HUNT

Well-known among radio amateurs, the fox hunt has nothing to do with chasing an innocent animal, but is the search by a number of radio hunters for a hidden transmitter.

The 'fox' proposed here is a small transmitter emitting a code in the 80-m band. It is powered by a 9-volt PP3 battery; during operation it draws a current of not more than 30 mA.

In Fig. 1, when the output of gate N1 is high and that of N2 is low, N2 generates a pulse stream with a duty factor of about 5%. The pulse repetition frequency is about 1 kHz.

The bursts of pulses are used to modulate the carrier generated by T1, which operates on a frequency between 3.3 MHz and 4.3 MHz. Note that T1 can work only when the output of N2 is low.

The AM tone burst is amplified in N3-N5 and then fed to an aerial via filter L1-L2-C7-C6. The shape of the filter response is sufficiently sharp to ensure adequate suppression of harmonics. The power transferred to the aerial is about 200 mW.

A small auxiliary circuit, consisting of a small VU meter and two diodes, is re-

quired for tuning the transmitter - see Fig. 2.

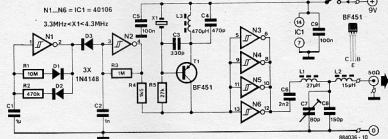
Terminate the transmitter with a 50-ohm resistor, connect the auxiliary circuit to the junction of L2 and aerial socket, and adjust C7 for maximum deflection of the meter.

The transmit antenna is made from 8 metres of suitable wire suspended vertically, for instance, from a tree - see Fig. 2. The base of the antenna is formed by three 4-metre long wires laid on the ground to form a suitable earth-plane. The inductor for the tuned aerial circuit consists of 42 turns (tapped at 4 turns)

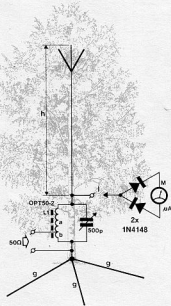
SWG30 (0.3 mm dia) enamelled copper wire wound on a Type T50-2 toroidal former.

The antenna is tuned by adjusting the 500 pF trimmer for maximum deflection of the meter connected to the antenna as shown in Fig. 2.

1

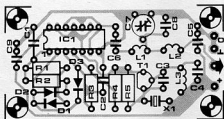


2



884036-11

L1a = 38 turns h = 8 m.
L1b = 4 turns g = 4 m.



Parts list

Resistors (± 5%):

R1 = 10M
R2 = 470K
R3 = 1M
R4 = 1K5
R5 = 27K

Capacitors:

C1 = 1µ0
C2 = 1n0
C3 = 330p
C4 = 470p
C5, C9 = 100n
C6 = 2n2
C7 = 80p trimmer
C8 = 150p

Inductors:

L1 = 27µH
L2 = 15µH
L3 = 470µH

Semiconductors:

D1, D2, D3 = 1N4148
T1 = BF451
IC1 = 40106

Miscellaneous:

X1 = quartz crystal 3.3 to 4.3 MHz.
S1 = miniature SPST switch.
PCB Type 884036

09

LIGHT-TO-FREQUENCY-CONVERTER

Siemens's Type TFA1001W integrated circuit makes it possible to convert light intensity into frequency. The IC contains a photo diode and an amplifier. It delivers a current into its open-collector output that is directly proportional with the light incidence on to the photo diode. The pinout of the IC is shown on the circuit diagram.

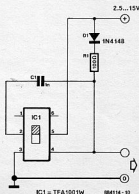
A capacitor connected between the amplifier output and the frequency-compensation connection ensures that the amplifier oscillates.

With a capacitance of 1 nF, the output frequency varies between 100 Hz and

100 kHz, depending upon the light intensity (supply voltage = 2.5 V). The output signal has a peak value of 2 to 4 V (depending on the supply voltage). The output load should not be smaller than 50 kΩ.

The supply voltage may be between 2.5 V and 15 V. A current of not more than 1 mA is drawn with no light falling on to the photo diode; it increases (to an extent that depends on the output load) when the photo diode is illuminated.

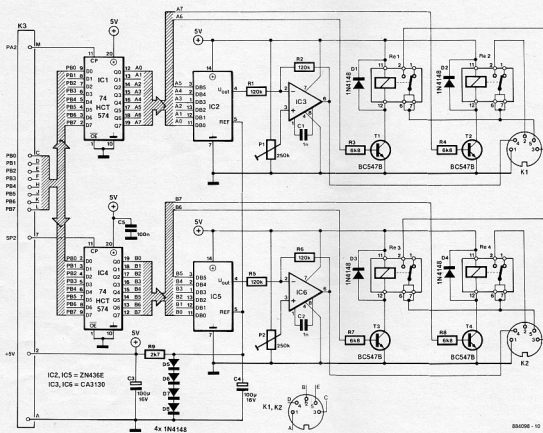
Siemens Application



IC1 = TFA1001W 884114-12

SLIDE FADER FOR C64

1



This slide fader is an adaptation of that published earlier in this magazine⁽¹⁾. It may be connected direct to the user port of a C64. In contrast to the earlier version, it can, however, control only two projectors.

The data provided by the user port of the C64 are buffered by latches IC1 and IC3. For which projector the data are intended is determined by PA2 and SP2. The latches are followed by a switching section and a D-to-A converter, IC2 and IC5 respectively. The converter provides the voltage for controlling the light intensity.

Then follows a stage, IC3 (IC6), that transforms data 000000 (A0 to A5) into a voltage of 2.5 V (lamp extinguished) and data 111111 into a potential of 5 V (lamp at full brightness).

Lines A6 and A7 are used to control forward and reverse transport of the slides via relays Re1 and Re2 (Re3 and Re4). The dimmer is the same circuit as used in the earlier version (see Fig. 2). It is built into the projector; note that the triac needs some cooling.

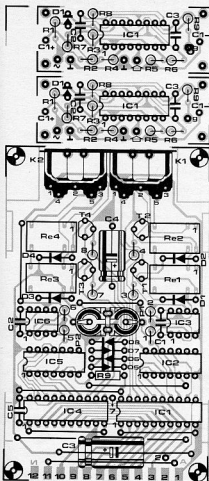
The control signals are transmitted via a 5-core cable terminated into DIN connectors. This means that the projectors should also be provided with a 5-way DIN connector wired in accordance with the circuit diagram.

Presetting is carried out with all inputs of the D-to-A converters at logic low: P1 and P2 are then adjusted until the projector lamps just (visibly) light. This improves the life expectancy of the lamps. The circuit board contains the control section for the projectors, and this may

be cut off. The connector for the user port is soldered to the track side of the control board. Two wires must also be soldered on the component side from terminals 2 and 7 to the corresponding pins on the connector.

After the PCB has been populated and fitted in a suitable enclosure, it is inserted (with components side uppermost) into the connector on the user port. The supply voltage is taken from this connector also.

A sample program for the forward and reverse transport of slides via the keyboard, including automatic fade in or out, is given in Fig. 3. The space bar and R-key are pressed for forward and reverse transport respectively.



Parts list

CONTROL BOARD:

Resistors ($\pm 5\%$):
 R1;R2;R5;R6 = 120K
 R3;R4;R7;R8 = 6K8
 R9 = 2K7
 P1;P2 = 250K preset H

Capacitors:
 C1;C2 = 1n0
 C3;C4 = 100 μ ; 16 V
 C5 = 100n

Semiconductors:
 D1... D8 incl. = 1N4148
 T1... T4 incl. = BC547B
 IC1;IC4 = 74HCT574
 IC2;IC5 = ZN436E (Ferranti)
 IC3;IC6 = CA3130

Miscellaneous:
 Re1... Re4 incl. = 12 V PCB mount relay;
 e.g. Siemens V23101-A0003-B101.

K1;K2 = 5-way DIN socket 180°.
 K3 = 24-way PCB connector for C64 User Port.
 PCB Type 884098

DIMMER BOARD:
(parts given for one board)

Resistors ($\pm 5\%$):
 R1 = 470R; 0.5 W
 R2;R7 = 100K
 R3 = 22K
 R4 = 330K
 R5 = 150K
 R6 = 270K
 R8 = 82K
 R9 = 150R

Capacitors:
 C1 = 470 μ ; 16 V
 C2 = 1 μ 2 (1 μ 0//220n)
 C3 = 1n5

Semiconductors:
 D1 = 1N4001
 Tr1 = TIC236 (to 150 W) or TIC246 (to 250 W)
 IC1 = TCA280

```

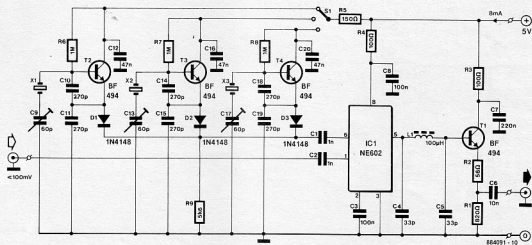
10 REM ... ELEKTOR C64 SLIDE CONTROLLER
20 A=56576:B=56577:C=56579:D=56588
30 POKE C,255
40 POKE 56580,65
50 POKE 56581,0 :POKE 56580,1
59 PRINT "-"
60 POKE B,0:POKE A,147:POKEA,151:POKED,128
70 PRINT "-"
80 PRINT "E ELEKTOR C64 SLIDE CONTROLLER"
90 PRINT "E"
100 PRINT "E"
110 PRINT "PROJECTOR 1" PROJECTOR 2"
120 PRINT "DATA=" :X
130 PRINT TAB(20); "C" DATA=:Y
140 PRINT "FORWARD = [ SPACE ]"
150 PRINT "REVERSE = [ R ]"
160 PRINT "*****"
170 X=1: Y=2: Z=0
300 GET AS: IF AS="" THEN GOTO 300
310 IF AS=">" THEN W=128: RE=200: GOSUB 600
320 IF AS="R" THEN W=64: RE=400: GOSUB 800
330 Z=X: X=Y: Y=Z
340 GOTO 300
350 END
600 REM FORWARD
610 GOSUB 4500
620 IF X=1 THEN GOSUB 4000
630 IF Y=1 THEN GOSUB 3000
640 FOR I=0 TO 200: NEXT
800 REM REVERSE
810 IF X=1 THEN GOSUB 3000
820 IF Y=1 THEN GOSUB 4000
830 FOR I=0 TO 100: NEXT
840 GOSUB 4500
850 RETURN
3000 REM CHANGE X
3010 POKE B,W :POKEA,147:POKEA,151
3020 FOR I=0 TO RE:NEXT

```

```

3030 POKE B,0 :POKE A,147:POKE A,151
3040 RETURN
3050 END
4000 REM CHANGE Y
4010 POKE B,W:POKE D,128
4020 FOR I=0 TO RE: NEXT
4030 POKE B,0:POKE D,128
4040 RETURN
4050 END
4500 REM WHICH PROJECTOR?
4510 IF X=1 THEN GOSUB 5000
4520 IF Y=1 THEN GOSUB 6000
4530 RETURN
5000 REM X ON Y OFF
5010 FOR I=1 TO 63
5020 FOR V=0 TO T:NEXT
5030 POKEI,I:POKE A,147:POKEA,151:GOSUB 10000
5040 IF Z=0 THEN GOTO 5060
5050 POKE B,63-I:POKE D,128:GOSUB 9000
5060 NEXT
5070 RETURN
5080 END
6000 REM X OFF Y ON
6010 FOR I=1 TO 63
6020 FOR V=0 TO T:NEXT
6030 IF Z=0 THEN GOTO 6050
6040 POKE B,63-I:POKE A,147:POKE A,151:GOSUB 10000
6050 POKE B,I:POKE D,128 :GOSUB 9000
6060 NEXT
6070 RETURN
9000 PRINT TAB(29); "C:"
9010 PRINT TAB(29); "C:PEEK(B):RETURN
10000 PRINTTAB(7); "C:"
10010 PRINTTAB(7); "C:PEEK(B):RETURN

```



The purposes of the prescaler, which is primarily intended as a prestage for the frequency meter in, say, an SSB receiver, are to lower the frequency to be measured and to prevent the frequent switching on the counter preset.

The circuit consists of a number of oscillators, a mixer and an output buffer/filter. Its operation ensures that the output frequency is equal to the input frequency minus the oscillator frequency. Since the oscillator frequency can be altered readily, the output frequency is easily adapted to make the meter read the received frequency. The oscillator frequency is altered simply but effectively by switching the supply voltage only to the required oscillator. The advantage of this arrangement is that the inoperative oscillators can not cause any interference.

To prevent the inoperative oscillators having any effect on the required oscillator frequency, the oscillator signal is fed to the mixer via one of diodes D₁ to D₃. This is because with an inoperative

oscillator the diode will not conduct, so that there is only a small capacitance to earth. When the relevant oscillator operates, the diode conducts and presents only a relatively small resistance.

Three oscillators are sufficient for most applications, but for some receivers it may be necessary to add one or two; this may be done without any problems. The crystal frequencies may be calculated as shown in the following examples.

In a simple receiver with a range of 1600-4400 kHz and an IF of 5200 kHz, the local oscillator runs between 6800 kHz and 9600 kHz. If the counter input frequency is 3 MHz max, the prestage frequency must not cause the output frequency of the mixer to be higher than 3 MHz. An oscillator frequency of 1600 kHz would, therefore, be suitable. This would result in crystal frequencies of

USB: $1600 + 5198.5 = 6798.5$ kHz
LSB: $1600 + 5201.5 = 6801.5$ kHz

AM: $1600 + 5200 = 6800$ kHz

In practice, this would mean three identical crystals that are pulled to the required frequency with the aid of a trimmer.

The SSB receiver in Ref. 1 has ranges of 3500-4000 kHz and 14000-14500 kHz, and an IF of 9 MHz. Prestage oscillator frequencies of 3 MHz for range 1 and 13 MHz for range 2 would give crystal frequencies of:

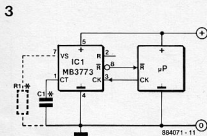
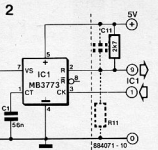
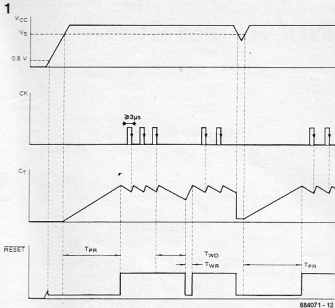
range 1 USB: $8998.5 - 3000 = 5998.5$ kHz
range 1 LSB: $9001.5 - 3000 = 6001.5$ kHz
range 2 USB: $13000 - 8998.5 = 4001.5$ kHz
range 2 LSB: $13000 - 9001.5 = 3998.5$ kHz

The Type MB3773 IC from Fujitsu can be used to give a reset when (a) the supply is switched on; (b) the level of the supply voltage has dropped below a certain value; and (c) the program has run into difficulties

Operation of the IC is best seen from Fig. 1, rather than from the circuit in Fig. 2. The upper two graphs show the voltages monitored by the IC: the supply voltage and a pulse-shaped signal that is generated continuously by

the program being run (for instance, via an I/O gate).

The points of origin of the graphs correspond with the switching on of the supply voltage.



1 0 3

CENTRONICS RELAY DRIVE

This circuit enables up to eight relays to be controlled via a Centronics printer interface. Since the computer 'sees' the circuit as a printer, the relays are driven by 'printing' characters.

In essence, the circuit consists of eight bistables (IC₁) functioning as memory and eight relay drivers (IC₂). The open-collector outputs of IC₂ can cope with up to 500 mA.

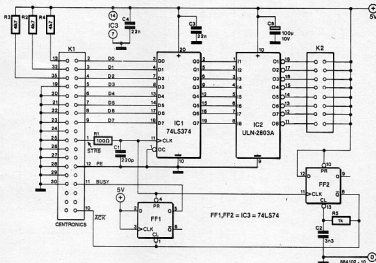
When the relay coils are connected between +5 V and a driver output, a 1 in the printed byte corresponds to an energized relay. Bistables FF₁ and FF₂ keep the data stream from the computer under control.

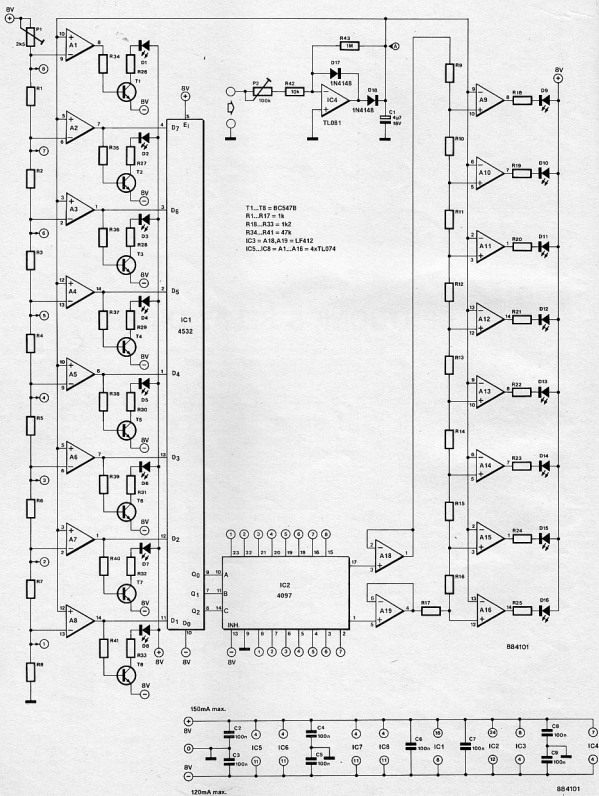
When a byte is written to the circuit, the data are put on to the data lines D₀ to D₇, and the computer renders the STROBE line low. This causes FF₁ to be set and monostable FF₂ is started. Because FF₁ is set, the computer is given the message that the circuit is BUSY. The Q-output of FF₂ transmits an ACK-signal to the computer. Subsequently, the STROBE will go high, upon which the data in the bistables of IC₁ are clocked. Finally, when the pulse duration of FF₂ lapses, FF₁ is reset, after which the next byte may be written.

Although the computer 'sees' the circuit as a printer, there are one or two problems. For instance, GWBASIC transmits a CR/LF to the printer on termination of the program. To many printers, this signifies 'erase print buffer', but with the present circuit it means that without

special precautions (machine language routine) it is not possible to leave the program without a change in the state of the relays.

Another problem is posed by computers that work with the 7-bit code: only up to seven relays can then be controlled.





Using only 16 LEDs, this VU meter can indicate 74 different signal levels, which makes it very suitable for use as a peak detector.

The input signal is amplified by A_{17} (10-100 times, depending on the setting of P_2), and rectified by D_{18} . The potential across C_1 is, therefore, equal to the rectified peak value of the input signal. This voltage is applied to the non-inverting inputs of comparators A_1 to A_{16} . Comparators A_1 to A_8 are provided with a fixed reference voltage that is derived from the supply voltage via the potential divider formed by P_1 and resistors R_1 to R_8 .

The outputs of A_1 to A_8 not only drive LEDs D_1 to D_8 , but are also connected

to the inputs of IC_1 . This circuit is an 8-bit priority encoder that converts the digital code at inputs D_0 to D_7 to an 3-bit number, Q_0 to Q_2 . This binary number is used to drive a dual 8-channel multiplexer, IC_2 .

Since the inputs of the multiplexing stages are supplied with the reference voltages for the first eight comparators (always with a voltage-step difference between two identical inputs), the reference level of the second set of eight comparators is automatically matched to the signal level at the input.

The step-difference between the reference voltage to comparators A_9 to A_{16} is one eighth that between the reference voltages to A_1 to A_8 . In practice, this

means that the upper eight LEDs have a resolution eight times better than the lower LEDs.

The output voltages of the multiplexers are buffered by A_{16} and A_{15} , the two sections of a dual opamp Type LF412. This type was chosen because of its low off-set voltage.

Dependent on the level of the input signal, some or all of the LEDs D_1 to D_{16} light. The bar formed by D_9 to D_{16} divide the next voltage range (one eighth of the scale) in eight sections. The advantage of this arrangement is that the resolution is virtually independent of the level of the input signal, and remains good even for low input levels.

1 0 5 SMALL LIGHT METER

Many electronic components are intended nowadays for the camera industry. One of them is Siemens's TFA1001W. This bipolar IC contains, apart from a photo diode, an amplifier and a 1.35 V voltage reference. Possible applications include light meters, electronic flashing equipment, smoke detectors, linear optocouplers, and so on.

The light meter presented here is very sensitive and has good linearity and low power consumption. It is housed in a compact case with six terminals.

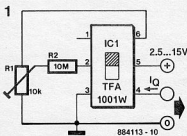
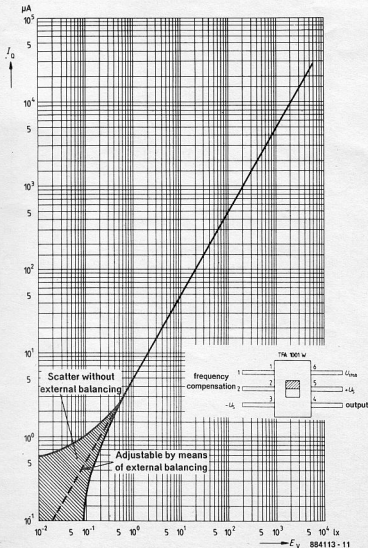
Other than the TFA1001W, the circuit contains only two other components. The supply voltage may vary from 2.5 to 15 V.

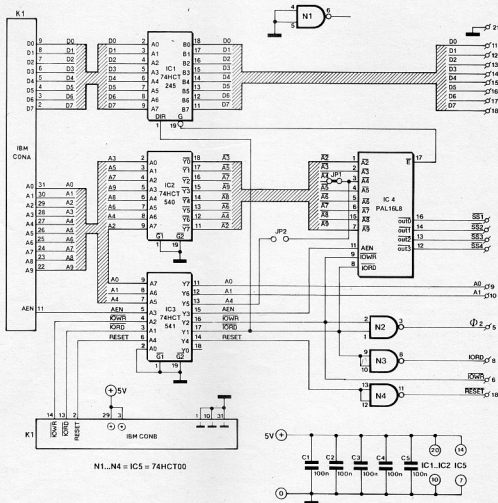
The output current, I_Q , (in essence the circuit is a light-controlled current-source) is a measure of the incident light flux - see Fig. 2.

The circuit may be preset for optimal linearity in the lower region of its range by P_1 . If the unit is used in a dark-room, its linearity may be set simply with the aid of the diaphragm in the enlarger. Every time the diaphragm is 'stopped', the light flux changes by a factor of 2. In other cases, comparison with an existing light meter is the simplest way of presetting.

If the circuit is used as a stand-alone light meter, a μA -meter must be connected between the positive supply line and output I_Q .

2 Photocurrent $I_Q = f(E_v)$





This I/O bus is based on those published earlier in this magazine ⁽¹⁾ for the C64 and MSX computers.

It is possible with only five ICs to make the signals of the extension slots on the IBM PC compatible with the timing and levels required by the I/O bus.

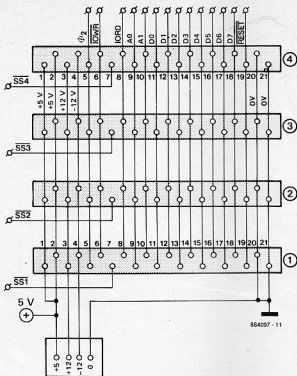
Circuits IC₁, IC₂ and IC₃ provide buffering of the data bus and address bus. The benefit of this is that the extension modules do not load the internal PC bus; it is also safer and more reliable. Circuit IC₄, a programmable array logic (PAL) device, is used for decoding the addresses.

The I/O bus consists of four slots, each of which has been allocated four addresses. Each slot has its own, active low, slot-select signal (SS1 to SS4). Since in the IBM PC addresses 0300hex to 0310hex may be used for I/O extensions, the adaptor card, which uses 16 places) may be placed at two different addresses. When wire link JP₁ is used, as shown in the diagram, the card is at address 0300hex. If link JP₂ is used, it is located at 0310hex.

The software for communicating with the card may remain very simple as shown in these Pascal examples:

writing: Port[306]:=output
reading: Input:=Port[302]
Advice for using the cards is given in Ref. 1 for MSX computers

In normal use, the card may remain in the computer without any problems: conflicts with existing PC cards, such as hard disk or video, are impossible. However, when several extension cards are used, care should be taken with parallel addressing.

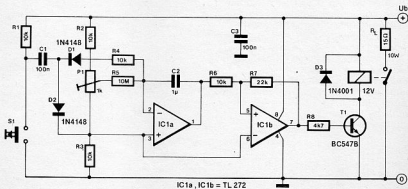


1 0 7

CAR-LOCK DEFROSTER

The defroster consists basically of a small heating element that is fitted around the barrel of the door lock. Some additional components arrange the switching on (and off) of the element.

Switch S_1 in the diagram is a microswitch that is connected to the door handle in such a way that when the handle is moved the switch is pressed. It would have been possible to use the switch to operate a timer, but this would have actuated the heating element also in the summer months. Therefore, S_1 is followed by a charge pump (IC_{1a}). Every time the door handle is moved, S_1 is closed and C_1 discharges via S_1 , which causes the potential across C_2 to rise slightly. Because of the ratio $C_1:C_2$, capacitor C_2 is (theoretically) fully charged after S_1 has been operated ten times. Circuit IC_{1b} is connected as a Schmitt trigger that has substantial hysteresis. After S_1 has been pressed seven times, IC_{1b} energizes the relay via T_1 . Capacitor C_2 then discharges slowly via R_8 . After a short time (1 to 2 minutes, preset by P_1), the potential at the output of IC_{1a} has decayed to a level where the heating element is switched off.



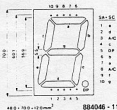
The quiescent current is smaller than 1 mA, so that the circuit may be connected permanently to the car battery. The heating element may consist of two 5-watt resistors that are clamped to the barrel with a metal strap. Heat generation is dependent on the value of the resistors: to prevent damage to the paint, it should not be too high.

If the control circuit is also fitted in the car door, it should be contained in a waterproof enclosure, because there is always a danger of water entering the door via the window.

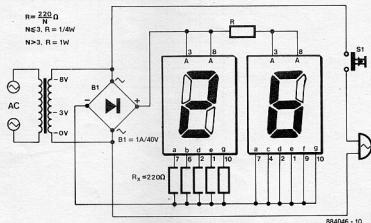
Kingbright's giant LED displays are eminently suitable for use in score boards, counters, large digital clocks, and so on.

Each display segment contains four LEDs in series (two for the decimal point). Because of this arrangement and the colour, the operating voltage is fairly high. For safety considerations, it is advisable to use a transformer in the power supply. Full-wave rectification is recommended, otherwise the display flickers just visibly. The rectified voltage need not be smoothed, however.

A resistor of about 220 ohms (depending to some degree on the supply voltage) may be connected in series with each segment to limit the current to about 20 mA per segment. If the number of operating segments is always the same, only one common resistor is necessary in the anode or cathode circuit; the segments must then be connected in parallel. The value of this single resistor, and its power rating, must, of course, be in accordance with the number of operating segments.



The displays are available in common-anode and common-cathode versions: the second letter in the type number (A or C respectively) indicates which version. Both versions come in four colours. A letter on the display (C to M) indicates the efficacy (70 to 5600 μCd per 10 mA — minimum values). Displays of Type K (minimum 2200 μCd per 10 mA) are bright enough to be seen clearly in good daylight.



colour	red	super red	green	yellow	
wavelength	λ 660	625	565	595	nm
forward voltage (typ.) ($I_F = 20 \text{ mA}$)	V_F 2,0	2,0	2,2	2,1	V
forward voltage (max.) ($I_F = 20 \text{ mA}$)	V_F 2,8	2,8	2,8	2,8	V
max. average current	I_F 20	30	30	30	mA
max. peak current ($t \leq 10 \mu\text{s}$)	I_F 150	150	150	150	mA
max. reverse voltage	V_R 5	5	5	5	V
reverse current ($V_R = 5 \text{ V}$)	I_R 100	100	100	100	μA

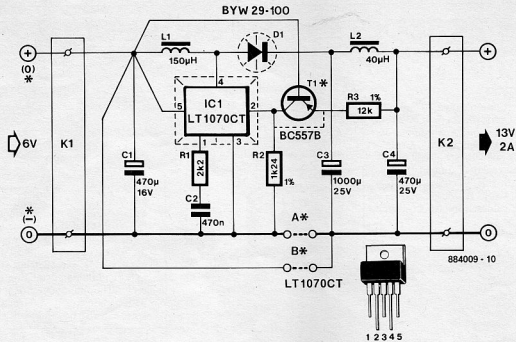
Owners of vintage cars and motorcycles fitted with a 6 V battery will find the converter described here useful for operating modern accessories such as a radio, revolution counter, and others. The converter raises the battery voltage to 12 V: its maximum output current is 2 A. It may be used with positive-earth

or negative earth chassis. This is made possible by wire links as shown in the circuit diagram.

The circuit operates on the flyback principle, for which use is made of an electronic power switch in IC1 that operates at a frequency of 40 kHz. At each operation of the switch, energy is stored in

inductor L_1 and subsequently transferred to capacitor C_3 via Di. A filter ($L_2 - C_4$) has been provided at the output to suppress switch-generated pulses on the output line.

With negative-earth batteries, wire link A should be used, and an additional link should be fitted between the collector,



and emitter connections of T₁ (T₁ is not used).

With positive-earth batteries, T₁ is used and wire link B should be fitted. The input to the circuit is then as shown in the brackets.

The efficiency at full load (6 A in; 2 A out) is around 70%; with smaller output currents, it may be a little higher.

Parts list

Resistors:

R1 = 2K2
R2 = 1K24F
R3 = 12KF

Capacitors:

C1 = 470µF; 16 V
C2 = 470n
C3 = 1000µF; 25 V
C4 = 470µF; 25 V

Semiconductors:

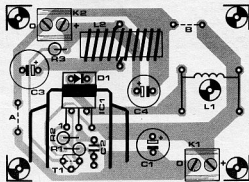
D1 = BYW29-100
T1 = BC557B
IC1 = LT1070CT (Linear Technology)

Inductors:

L1 = 150µH; 3 A
L2 = 40µH; 3 A

Miscellaneous:

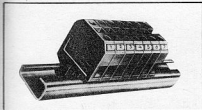
K1, K2 = 2-way terminal block.
Heat-sink for D1 and IC1.
PCB Type 884009



NEW PRODUCTS • NEW PRODUCTS • NEW

Terminal Blocks

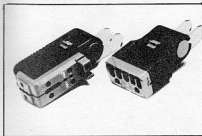
'IEC-Vejay' Clip-on type Terminal Blocks offer a versatile method of electrical cable connection. Any number of terminals can be assembled on a standard mounting rail with a choice of different ratings and sizes. Terminal Blocks are available to suit Electrical installations upto 650 - volts AC or DC and can accommodate cables from 1.5 sq. mm upto 35 sq. mm



Asia Electric Company • Katara Mansion • 132 A Dr. Annie Besant Road • Worli • Bombay 400 018.

Cable Stripper

The TOR-1C Coaxial Cable Stripper and the TOR-1F Dual Line Stripper are an ideal complement to the electrical and electronic technicians tool kit.

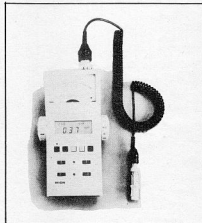


Davle Tech Inc. • 2-05 Banta Place • Fair Lawn • New Jersey 07410.

Vibration Analyzer

Machine Analyzer MK 300 is the portable analyzer (about 6 kg.) with built-in soft ware programmes for automatic machine diagnosis, for on the spot determination of causes and location of machine problems. This instrument, with built-in programmes based on vibration frequency analysis technology analyzes the vibration data and displays the resultant diagnostic information,

such as misalignment, imbalance abnormal bearings or gears, automatically. The analysis unit has the frequency large from 10 Hz to 20 KHz, a built-in unit, a built-in graphics printer, built in memory unit and an RS 232C output standard.



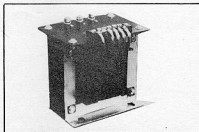
Record Marketing Pvt. Ltd. • 304 Hill View Industrial Estate, • Ghatkopar (West) • Bombay-400 086. Phone: 588552.

Inverter Transformer

MU-NETIC Inverter Transformers are essentially inverter cum charger Transformers available in 150 VA, 250 VA, 500 VA and 1 KV A models, with 12V-O-12V or 24V-O-24V at Primary and 10V-O-190-210-230-250V at Secondary. These are air cooled, double wound, base mounted, Class A, 50 Hz. Transformers provided with appropriate termination arrangements.

MU-NETIC Inverter Transformers manufactured by Electro Service (India) are tested to meet the routine test requirement of IS-6297 (Part-II).

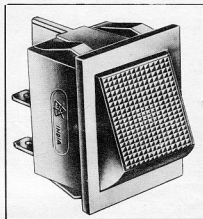
Non-standard Inverter Transformers are also manufactured against Customer's specification.



Electro Service (India) • 232 Russa Road South • First Lane • Calcutta-700 033.

Rocker Switches

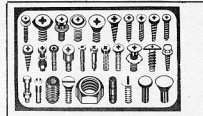
'IEC' offers a line of Snap-Fix type Rocker Switches in 6 Amps & 16 Amps, 250 Volts AC or 28 Volts DC. The range includes single pole and double pole with ON-OFF or changeover or momentary contacts. A choice of terminals, viz., solder, screw or quick connect plug-in type are available. The switches are available in both illuminated and non-illuminated type. The illuminated Rocker switch with a choice of Red, Green or Amber lens can also be offered as 'Pilot' lamp.



Indian Engineering Company • Post Box 16551 • Worli Naka • Bombay-400 018.

Screws

PIC Manufactures a large range of fasteners for a variety of applications.



Precision Industrial Components • F-Marine House • 11-A Navroji Hill Road • Dongri • PB No. 5153. • Near Sandhurst Road Rly Station (W) • Bombay-400 009. • Phone: 861213 - 8553750 - 8724815.

NEW PRODUCTS • NEW PRODUCTS • N

Hi-Tech Materials

M/s. A.A. Technology 2000 Pvt. Ltd. represents five leading companies in the field of semiconductor technology and related services. Metal Finishing Engineers (H.K.) Ltd. - Experts in lead frame plating technology, Alphasem AG - Leading manufacturers of die bonders and wire bonders, Sumitomo Metal Mining Co. Ltd. - Manufacturers of alloy preforms, bonding wires, lead frames, crystals, laser rods, thick film paste and Samarium-Cobalt alloys, Possehl Hong Kong Precision Machining Ltd. - Experts in precision machining, moulds and dies, CAD/CAM International - Experts in CAD/CAM for the Electronics Industry and Semiconductor Industry.

M/s. A.A. Technology 2000 Pvt. Ltd. have already set up an office near the International Airport, Delhi, and will be soon setting up a sophisticated laboratory for providing technical service to the custome customers.

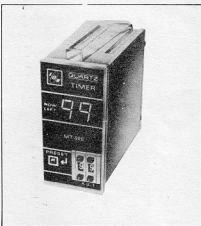
For further information, write to: • A.A. Technology 2000 Pvt. Ltd. • A-II-8, Palam Vyapar Kendra, • Palam Vihar, P.O. Carter Puri, • Gurgaon-122 001 • Haryana.

Count-Down Timer

This new timer provides automatic electrical cut-off after a pre-set duration. It has a two-digit, 12.5 mm red LED display and is presettable by two decade switches. Four different ranges are available: 0.1 to 9.9 seconds, 1 to 99 seconds, 0.1 to 9.9 minutes or 1 to 99 minutes.

The timer works on $220 \pm 15\%$ volts A.C. mains supply and provides a set of Change-over relay contacts, rated 5 amps (resistive) at 220 volts A.C. When the supply is connected, the relay activates instantly and the display reads the set time. It then counts downwards, showing the remaining time. When the reading reaches zero, the relay cuts-off. This is sequence type 'DDE', Alternative sequence 'DE' can be provided, where the relay energizes when the set interval elapses. The timer can be re-started by interrupting the supply momentarily, or simply by pressing the 'PRESET' button on the front.

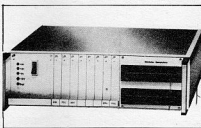
Barrier terminal blocks are provided at the back side, for external electrical connections.



ION Electricals • 1/1 Mahalaxmi Engineering Estate, • 571, L J Cross Road 1 • Mahim (W) • Bombay 400 016 • Tel. 46 77 35, 46 81 57

Modular Computer

The Unit comes complete with two 5 1/4" Floppy Drive. Video monitor alongwith keyboard is all that is required to complete the system. This is available in standard 19" Rack with all Eurobus boards. A printer of required capacity and specification can be connected to the Rack. Additional 3 Slots are provided for user defined expansion, such a system can be used as development system for programme development and debugging.



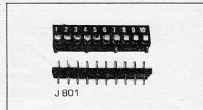
Arun Electronics Pvt. Limited • B/125-126 Ansa Industrial Estate • Saki Vihar Road • Bombay 400 072. Tel: 58 33 54/ 58 71 01.

Modular Terminal Blocks

G. H. Industries introduces Linear Plug Connector with Screw connection. The Male part can be soldered on PCB and wires are screwed on the Female Terminal Block. Pitch 5.0 mm OR 5.08 mm, Pin Dia 1 mm.

Current capacity : 5 AMPS. Operating Voltage : 250 Volts

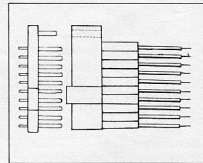
Breakdown : 2 KV. Contact resistance : Less than 15 milli ohms.



G. H. INDUSTRIES • 84-B, Government Industrial Estate • Kandivli (west) • Bombay-400 067. • Phone: 605 0097, 605 3277

Relimate Connectors

M/s. HARISONS introduces Relimate Connectors in Pitch 2.5 mm, Pin Dia 0.8 mm. Range available 2 to 22 way. The connector can be directly replaced to Imported Type of connector without changing PCB Hole dimensions. It can withstand wave soldering temp. The wires are soldered by semiautomatic soldering machine. Current Rating 3 AMPS. Operating Voltage 50 Volts.



HARISONS • 84-A, Government Industrial Estate • Kandivli (West) • Bombay-400 067 • Tel. 605 3277, 605 0097

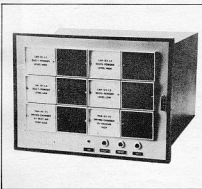
NEW PRODUCTS • NEW PRODUCTS • N

Alarm Annunciator

ICA Alarm Annunciator is a centralised fault indicator for diverse applications including Power Generation, Fertilizers, Chemical & Petrochemical Complexes and variety of process Industries.

Type tested from Government approved laboratories like CPRI, Bangalore & IDEMI Bombay the unit uses CMOS Integrated Chips. Any sequence can be given with the help of EPROM. Various types of inputs like voltage, current, can be accepted. Inputs are optoisolated. Dual lamp indication for each Alarm is provided with cold current bias. Additional outputs are provided to mimic indication or interlocking.

The system is available in Integral and in split architecture with modular design.



M/s. Industrial Controls & Appliances Pvt. Ltd. • 47-49A, Chakala Road, • An-
dheri (East) • Bombay-400 093.

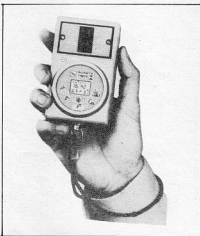
Quartz timer

This battery operated hand-held timer is designed for laboratory, Sports, industrial engineering and many other timing applications, and can be also used as an alarm time piece. It features a low power C-MOS LSI Chip, 6 digits LCD display and quartz control for precision timing. Rugged construction, use of standard penlite dry battery and ease of operation make MQT 86 an ideal choice for constant use.

The count-down timer is adjustable upto 11 hours and 59 minutes. Once set, it can be started by presetting button. The display then counts down to 00:00/00 and

jumps to the original setting, ready for the next use. At the same time instant, a buzzer beeps for 10 seconds. The count down can be 'held' or resumed by the pressing the start/stop switch.

Chronograph function is also available in MQT 86. This mode is useful for measuring time intervals upto 12 hours. Resolution is 1/100 seconds for first 30 minutes.



Promotion • Blk. # 4, Flr. # 1 • 10, Sub-
hash Cross Lane • Bombay-400 057.

Digital Ohmmeter

ECONOMY has introduced Bench type instrument for the measurement of various resistors in manufacturing process of Electrical Heaters, coils, relays. Also useful for the electronic industries for inspection of proper values of resistances before these are stored for production department, testing laboratories and R&D centres.



3½ digit, 7 segment RED LED display, 7 Measurement ranges with lowest range of 2 ohm with 1 milli ohm resolution and highest range of 2M ohm with K ohm resolution. Other ranges 20 ohm, 200 ohm, 2K ohm, 20K ohm and 200K ohm. 4 wire measurement. Accuracy $\pm .1\%$ of range $\pm .1\%$ of reading ± 1 digit.

Economy Electronics • 15 Sweet Home •
Plot No. 442 • 2nd Floor • Pitamber
Lane • Off Tulsī Pipe Road • Mahim •
Bombay 400 016.

Tetracon system

Tetra-CON is a universal microprocessor based control system, introduced by TETRATECH ELECTRONICS. It can be used for industrial control and automation applications, either directly by the user or by manufacturers of control panels and automation systems as an OEM module. Tetra-CON can also be used in various types of machine control applications and for automation of existing machinery.

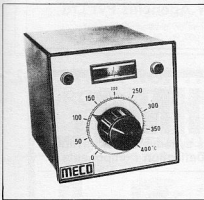
The Tetra-CON system consists of two standard cards, one CPU card and one Keyboard/Display card. Custom built interface cards can be used for system expansion. The basic system provides 32 Input/Output lines, one Rs 232 compatible serial channel, display upto 8 digits and keyboard upto 20 SPST keys. Analog, Optoisolated Input/Output, Relay output and other interfaces can be provided on interface cards as per customer requirements.

TETRATECH ELECTRONICS • 10
Usha, Opposite Central Bank, • Hanu-
man Road, Vile Parle (East), • Bombay-
400 057

NEW PRODUCTS • NEW PRODUCTS • NEW

Digital Temperature Indicator/Controllers

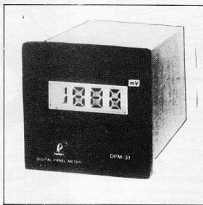
'MECO' Digital Temperature Indicator has been designed for inputs from Thermo couples RTD (Pt 100) or Semiconductor. Depending upon the sensor used, the indicator can be calibrated from -200°C to 1600°C. The cut off temperature can be set by thumb wheel switches, potentiometer or push button. The control Accuracy is $\pm 1^\circ\text{C}$. Indication Accuracy depends on the type of indicator used $\pm 0.1\%$ FS to 1% FS). The output is thoroughly relay contacts (Potential free) rated to 5 Amps at 230V AC. The instrument is provided with Automatic cold junction compensation. Bright Red 0.5" LED's display the temperature. The Dimension conform to DIN standard 96 x 96 mm.



Gujarat Electrical Instruments • Plot No. 624 • G.I.D.C. Estate • Phase IV, Naroda • Ahmedabad-382 330.

Digital Panel Meters

PUNEET make Digital Panel Meters are made in standard DIN size of 96 x 96 mm. and in the open card Types for measurements of 57 parameters like AC/DC Voltages and currents, frequency, wattage, resistances, temperature, PH etc. It is operated on Mains or +5 VDC and measures upto 2000 V and 2000 A. They are suitable for use in Controls Panel and industries like electronic, chemicals, pharmaceuticals, power generation, cable & transformer manufacturing instrumentation, and by hobbyists, servicing personnels, R & D and laboratories.

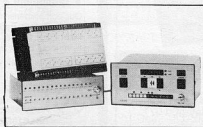


M/s. Puneet Industries • H-230, Ansa Industrial Estate • Saki Vihar Road • Bombay-400 072.

Programmable Sequencer

ICA Programmable Sequencer Model 1155PS is a microprocessor based time control unit for any kind of timing and sequencing requirement. The applications range from batch processing in chemical plants, Foods processing Water Treatment Plant, Automation of Process and other Cyclic operations. Operations Cycle of the Sequencer is divided in Number of Stages (Max.94). Each stage is on line Programmable upto 99 hrs, 59 Min, 59 second with programmable output combination. Maximum capacity of 96 outputs in Multiple of 16 (Modular design).

The Sequencer can be programmed for single run or Cyclic Operation. Upto 8 Programmable inputs for interlocking or for remote operation of sequence are provided. Total Manual Control for each output. Outputs is provided in the form of Potential free contacts, rated at 230V, 5A.



Industrial Controls & Appliances Pvt. Ltd. • 47-49A, Chakala Road • Andheri (East) • Bombay-400 093.

Microsequencer

Micronix offers a fully programmable microsequencer for use in automatic control of standard hydraulic presses. The unit has a lot of flexibility in design of press control circuitry which is not offered by conventional contactor logic design. The unit also has all Timers and counters build-in.

Salient features include:

Extremely easy programming method to allow even an unskilled operator to handle the system without special training.

Membrane-touch panel Keyboard.

4-digit multipurpose display alongwith status indicators to monitor full system status at all times.

Fully modular construction with opto-isolated card designs.

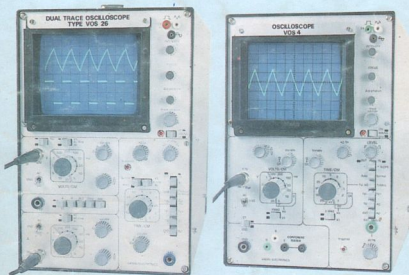
Optional battery back-up to retain programmed data during power failures. Mode of operation include Manual, single cycle or fully automatic cycles with all the required interlocks.

It accepts a variety of inputs such as microswitch, optical or proximity sensors. It provides change over contacts for control outputs. The unit works on 230 VAC and is enclosed in DIN standard enclosures suitable for panel mounting.



M/s. Micronix • D-74, Angol Industrial Estate • Udyambag • Karnataka-590 008.

OSCILLOSCOPES



Unique 3 Terminal Component Tester
1mV/div. Sensitivity, Z-Modulation
X-Y Operation, X-Y Magnifiers, X-Y Variable Controls
TV Line & TV Frame, Trigger Indicator

DIGITAL LCR METER



For direct measurement of Inductance
Capacitance & Resistance with the highest possible
ranges and Simultaneous display of Tan Delta

VLCR1 is the only instrument in India covering
the Widest ranges of 0.1 pf/uH/m ohm (i.e. 0.0001 ohm.)
to 20,000 uf/2000H/20 M ohm.

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V
I

**VASAVI
ELECTRONICS**

M/S. CHENY TRADE CENTRE
Parklane,
Secunderabad 500 003
Tlx. 0420-6834 VEE. IN